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THE YERKES OBSERVATORY.

America has now obtained a very gratifying position in the scientific world, not only by reason of the individual efforts of her scientific men, but also on account of the splendidly equipped institutions maintained by the government or through the munificence of private individuals. The poorest citizen can write to the proper bureau at Washington on any scientific question germane to that bureau or division which may puzzle him and he will receive a prompt and courteous reply, either dictated by or passed upon by some specialist of reputation. The value of our Smithsonian Institution is recognized all over the civilized world, and in astronomy it is gratifying to note that the astronomers of America have had their researches properly recognized abroad.

The United States is fortunate in possessing observatories equipped with the two greatest refracting telescopes in the world—the Lick and the Yerkes observatories, situated respectively at Mount Hamilton, Cal., and Williams Bay, Wis.

The Yerkes Observatory, of the University of Chicago, was founded in 1892 through the liberality of Mr. Charles T. Yerkes, prominent in railroad circles in Chicago. Williams Bay, near Lake Geneva, Wis., was selected as a good location for astronomical work. The contract for the 40 inch object glass, the largest in the world, was awarded to Mr. Alvan G. Clark, in 1892, and that for the equatorial mounting to Messrs. Warner & Swasey, of Cleveland, O., who made the mountings for the great telescopes at Washington, D. C., and Mount Hamilton, Cal. The mounting of the Yerkes telescope, though not entirely finished, was exhibited at the World's Columbian Exposition in 1893. It is similar to that of the Lick telescope, but is heavier and more rigid.

ERECTING THE DECLINATION AXIS OF THE YERKES TELESCOPE.

The optical glass for the objective was made by Mantois, of Paris, which is the only concern capable of turning out disks of the required size. The object glass required two years of unremitting labor to finish it. It has been examined by a committee of experts and it was found entirely satisfactory. The definition was found to be fully equal to that of the Lick telescope, and Prof. C. A. Young states that it gathers 23 per cent more light than the hitherto unrivaled objective in the Lick Observatory. The great glass will do honor to the sole survivor of the famous firm whose product is recognized even by foreign governments, for the Clarks furnished the 30 inch lens of the Pulkowa Observatory.

The crown glass lens of the great object glass is double convex, about 2½ inches thick in the middle, though only ¾ of an inch at the edge. It weighs 200 pounds. The flat surface of the plano-concave flint glass lens faces the eye of the observer.

This lens is about 2 inches thick at the edge and 1¼ inches in the center, and weighs over 300 pounds. The two lenses are separated by a space of 8⅜ inches, and are set upon aluminum bearings in a steel cell itself weighing 500 pounds; so that the whole mass which has to be carried at the upper end of the telescope tube amounts to nearly a thousand pounds.

The focal length of the object glass is 61 feet; so that the total

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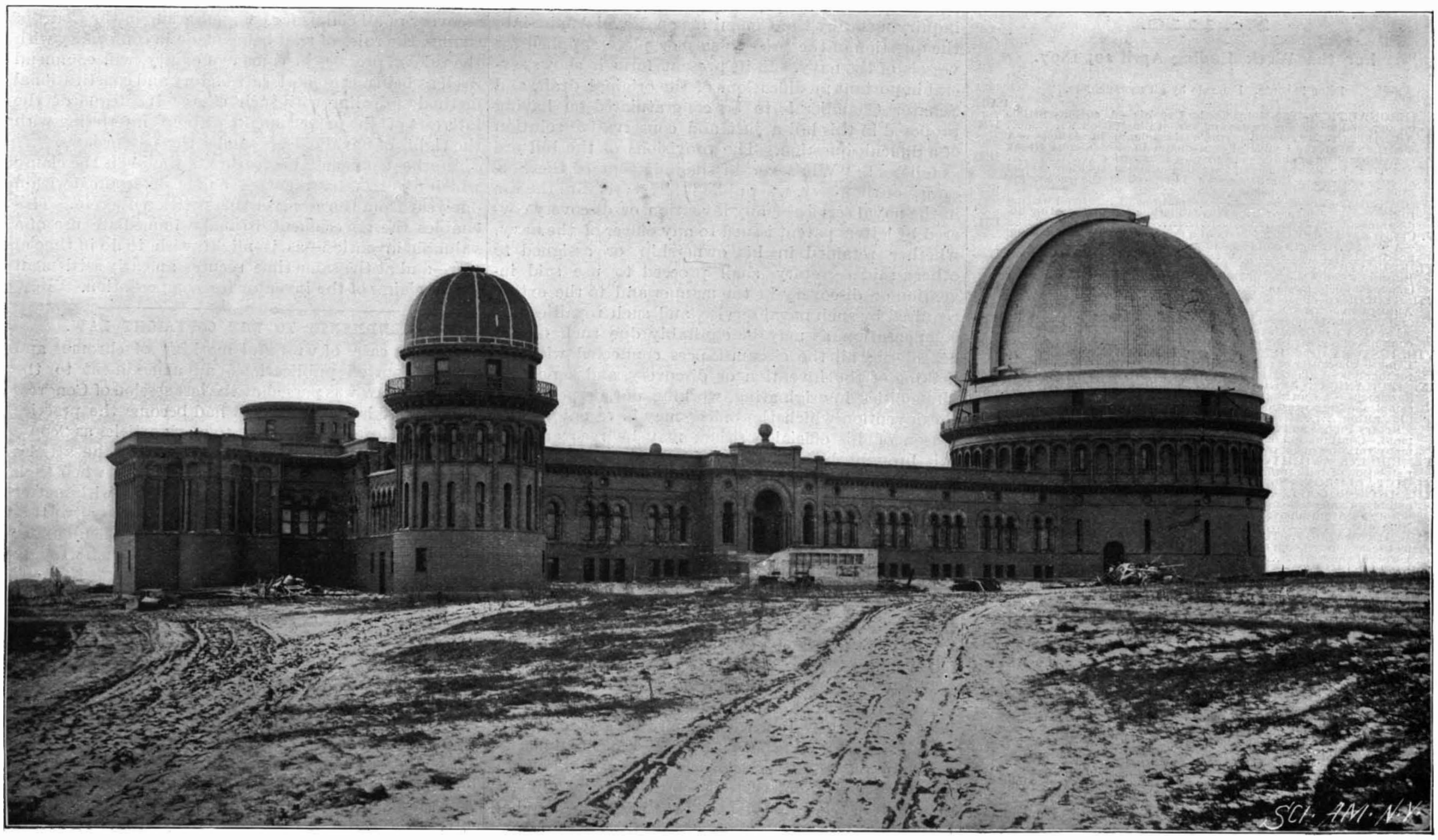

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A BILL TO PROTECT INVENTORS.

A bill has recently been introduced into Congress which is designed to put a stop to the "Lottery System" as applied to the patent practice.

Senator Hansbrough has introduced the following bill into the United States Senate:

Section 1.—That hereafter it shall be unlawful for any person or persons, firm or corporation, engaged in procuring and prosecuting patent claims to offer or award to their business correspondents or clients any gift, prize, or chance to win one, medal of honor, certificate of stock, or any other article or thing of real or supposed value, intrinsic or otherwise; and any person or persons violating the provisions of this act shall be deemed guilty of a misdemeanor, and on conviction thereof shall for each offense be punished by a fine of not less than $500 and not more than $1,000, or by imprisonment at hard labor for not less than six months nor more than one year.

Sec. 2.—That all applications for patents which may hereafter be filed by or through an attorney, or any person representing himself as such, shall be accompanied by an affidavit of such attorney or person that he has not violated the provisions of the first section of this act, and that false swearing thereto shall constitute perjury.

The granting of a valid patent by the government is properly regarded as an ample reward for a deserving invention, and one that is satisfactory to most inventors. The bill is so explicit in the description of the abuses it is intended to correct that further comment is unnecessary.

THE NEW COMMISSIONER OF PATENTS.

Hon. Benjamin Butterworth, of Ohio, has been nominated by President McKinley as Commissioner of Patents to succeed Commissioner Seymour. Mr. Butterworth was fourteen years a representative in Congress from Ohio, and has been for many years prominent in official and social circles in Washington. He was formerly Commissioner of Patents under President Arthur, from November 1, 1883, to March 23, 1885. During some years past he has made Washington his place of residence, and has built up a large law practice there, devoting his attention particularly to patent law. His preparation, therefore, has been an ideal one for satisfactorily filling this important office with great advantage to inventors and to the country. We congratulate the President in appointing to this important office a gentleman of such attainments and such unusual training for the position.

RELATION OF THE GOVERNMENT TO THE PATENTS OF NAVAL OFFICERS.

A bill has been introduced in the Senate and referred to the Committee on Naval Affairs, providing for the use by the United States of devices invented by its naval officers while engaged in its service, and covered by letters patent. In common with section 7 of the amendments to the patent statute, to which we referred in our last issue, the present bill is the outcome of an inquiry made by the Committee on Naval Affairs into the question of the prices of armor plate supplied for vessels of the navy. In its present form it shows several important modifications of the original draft, and Senator Chandler is to be congratulated on having proposed in this bill a just and conservative solution of a difficult question. The provisions of the bill are as follows: "Whenever, in the judgment of the Secretary of the Navy, the public interests require the use in the naval service of any invention or discovery covered by letters patent issued to any officer of the navy, whether retained in his ownership or assigned to others, said secretary shall proceed to use said invention or discovery in the manner and to the extent required by such naval service, and such royalties and compensation as may be equitably due such officer, considering all the circumstances connected with the making of the invention or discovery, and especially all facilities in originating, working out, or perfecting the invention which the officer may have enjoyed by reason of his official position, may be recovered by suit brought by said officer in the Court of Claims. Said court shall make rules for the trial of such cases, conforming as far as may be with the rules established by the Supreme court for the practice in courts of equity, and all cases shall be determined within one year from the filing of the petition therein, unless, in the discretion of the court, upon sufficient cause shown, the time is extended. The Secretary of the Navy is hereby prohibited from making any contract or payment for the use of any patent taken out by any naval officer."

The inquiry by the Naval Affairs Committee was too lengthy to allow of our making any detailed reference to it at present. It turned chiefly upon the history of the Harvey and other patents for the manufacture of armor plate; the relations of certain naval officers to these patents and their use by the navy; and the question of certain contracts for armor which had been made by the Secretary of the Navy without previous advertisement and competition. The record of the inquiry and the concluding recommendations of the committee seem to carry a color of unfriendliness to the patentee, at least so far as he may "become a burden upon the government." If such unfriendliness was shown, it was because of a misapprehension of the true relation of the government to the patent system, and of the intrinsic value of the patent to the government, considered as a user. For it is certain that the government will never adopt a patented invention unless it is of the opinion that, all things considered, it will be a gainer thereby. The fact that it is willing to pay a royalty is surely sufficient proof that the patent is not in any sense a burden, and it is certain that the payment of royalties can no more justly be termed a "burden upon the government" than the fulfillment of any other financial obligations for which a valuable equivalent is given.

In the case of the Harvey patents, which figured so prominently in the investigation, it transpired that Mr. Harvey's first patent, taken out in 1888, was for making a steel suitable for tools; that, at the suggestion of Commander Folger, he applied his hardening device to the manufacture of armor plate; that the consideration of his application was expedited at the request of the Secretary of the Navy; that, as the result of contracts made with the Harvey Steel Company, it received $96,056 as a royalty on armor plates used up to July 19, 1892, and a royalty of half a cent a pound on any additional plates that might be used. Such, in brief, is the history of the government's connection with the Harvey patents. To an impartial reader it can simply suggest that the Navy Department was desirous of using a valuable device, and that it paid only a reasonable amount for the privilege. No doubt $96,056 is a large sum of money, considered by itself; but it sinks into insignificance in comparison with the enormous benefits which accrued to our navy when it adopted Harveyized armor for its ships. Face-hardened armor gave to our battle ships an efficiency which was unapproached by any navy of the world, and raised our prestige to as high a position as it held during the naval operations of the civil war.

The question of the use by the government of devices invented by its naval officers is complicated by the fact that such officers enjoy special facilities for experimental work, and that the invention of a naval officer may be due as much to the extraordinary opportunities afforded by his official position as to his own individual ability. In this respect he has a material advantage over the civilian inventor, and it is only natural and just that the government should be in a position to determine the amount of royalties and compensation which are due such an officer.

As we have already said, the present bill is admirably adapted to cover the case. It is relieved of a certain fatal clause which was carried by the previous bill introduced by Senator Chandler during the last Congress. This clause declared that "hereafter no patent shall be issued to any naval officer without the written approval of the Secretary of the Navy"—a restriction which, for obvious fundamental reasons, would have effectually barred the passage of the bill. The provision for the recovery of all claims for compensation in the Court of Claims, the rules of trial being made in conformity with the rules of practice in courts of equity, will commend itself as being the most satisfactory and constitutional method of dealing with such cases. It safeguards the interests of the government without interfering with the rights of naval officers under the patent laws.

Another commendable feature of the bill is the clause which requires that all cases shall be determined within one year from the filing of the petition therein. This enables the government to make immediate use of a valuable invention—as it might wish to do in time of war—and at the same time secures an early settlement of the claims of the inventor for compensation.

AMENDMENTS TO THE COPYRIGHT LAW.

To meet cases of wrongful marking of chromos and other imported publications, an amendment to the copyright law was passed at the last session of Congress and became law March 3. It had become the practice with some foreign publishers to mark articles as "copyrighted," thus giving the impression that the articles had been copyrighted in the United States when such was not the case, and this was often done with matter not properly subject to copyright, as mere advertisements, circulars, ruled sheets, etc. It was difficult under the old law to reach the domestic dealer in such wrongly marked publications.

It will be remembered that the former copyright law imposed a penalty of one hundred dollars for marking as copyrighted articles for which a copyright had not been obtained. The new law, which is an amendment to section 4,963 of the copyright laws of 1891, makes the penalty of one hundred dollars further apply to the marking as copyrighted of articles not subject to copyright, and to the issuing, selling or importing of books, chromos, photographs, etc., bearing a copyright notice, but not copyrighted in the United States. Further than this, such importations of articles bearing notice of copyright, but not actually copyrighted here, are prohibited, and the courts are authorized to enjoin the

issuing, publishing or selling of such articles at the suit of any one complaining.

Another amendment to the copyright law pertains to section 4,966, and was enacted January 6, 1897. It prohibits the unauthorized public performing of copyrighted musical or dramatic compositions, under penalty of not less than one hundred dollars for the first and fifty dollars for each subsequent offense, or such performance may be judged a misdemeanor if it be willful and for profit. An injunction granted by any circuit court in restraint of such performance is also made operative in any other circuit in the United States. This law was enacted to protect playwrights and theatrical managers, and prevent traveling companies from pirating their plays. Heretofore these companies could evade process by traveling from one judicial district to another, and the financial irresponsibility of many of them made a judgment against them of little or no value. It is said, however, that the law goes further than was intended in respect to musical compositions, as composers and publishers generally like to have their music played, in order that a demand may thus be created and more copies of their music sold.

GEMS OF QUARTZ ORIGIN.

Mr. George F. Kunz, in the New York Sun, writes the following: Rock crystal is the purest form of quartz, transparent, colorless, and exhibits most perfectly the properties of the mineral. It is widely distributed, but is brought chiefly from Brazil, Madagascar, Japan, and North Carolina. It is wrought, especially by the Japanese, into polished crystal balls and other articles of elegant ornament. The Romans made much use of it to incise their intaglios, and it has been worked into vases and caskets from the time of Nero to the present, but especially during the fifteenth and sixeenth centuries. Remarkable crystal objects are to be seen in the Louvre, the Green Vaults of Dresden, the Schatzkammer at Vienna, and at Madrid.

Spheres of rock crystal were used as show stones and for divination from the thirteenth to the eighteenth centuries. The engraving and cutting of some of these was so elaborate as to cost years of work and thousands of dollars. Spheres have been cut up to eight inches in diameter, and valued at from $1,000 to $20,000. Nearly the latter price was paid by the late Gov. Ames for the magnificent crystal ball bequeathed to the Boston Fine Arts Museum. This ball measures 185 mm., or 7¼ inches. It was found in 1876. The crystal from which it was cut was 18 inches high, 14½ inches wide, and 12 inches thick. It was found on the Ortake-muko-Yuma, province of Kohi, Japan, originally the property of Naito Arimori, and purchased from Naito Tuskuba for 18,000 yen—about $18,000. It was cut by an old workman, who had devoted his entire life to cutting rock crystal balls. This one was started in June, 1891, and finished in December, 1894. The ball weighs nineteen pounds. The famous Dresden ball measures 6¾ inches and weighs 16½ pounds, but is quite imperfect. A five inch ball cut from material found in Ashe County, North Carolina, and another nearly six inches in diameter, from the summit of Mount Antero, Colorado, are now in the Field Columbian Museum in Chicago. Though not entirely perfect, they are quite equal to the balls of the eighteenth century.

At Hot Springs, Ark., clear, rolled pebbles found on the banks of the Ouachita are often sold. These are more highly prized than the quartz crystals, as the fancy prevails that they cut clearer gems. The scarcity of these, and the demand for them, has led to their artificial production, by putting the crystals into a box which is kept revolving for a few days by water power. Any expert, however, can discern the difference, since the artificial ones have a little whiter surface.

Many places in Colorado furnish fine specimens, and along the New Jersey coast and Long Branch, Atlantic City, Cape May, and other places, transparent pebbles are found in the sand and are sought after by the visitors, who often have them cut as souvenirs. At such places the local lapidaries have been known to substitute for pebbles from the beach foreign-cut quartz, cairngorm, topaz, crocidolite, Ceylon moonstone, and even glass, obtaining twice the value of the foreign gem for the supposed cutting. Sometimes even the stones found by the visitors are exchanged for cut ones from Bohemia, Oldenburg, and the Jura. Cutting is done abroad on so large a scale and by labor so poorly paid that the cut stones can be delivered in this country at one-tenth of the price of cutting here, because the rock crystal itself has but little value.

Amethyst is a transparent purple variety of quartz, its color being due to oxide of manganese. It is a very beautiful stone, much used by the ancients to engrave on, but certain varieties are now but little valued, because not rare enough to be costly. It is found in Brazil, Ceylon, India, and the Ural Mountains. In the latter region, near Mursinka, are found superb deep purple gems, changing to red by artificial light, some of which have sold for $500 each. For intensity and perfection of color, and, one might say, majestic beauty, these rival almost any other gem. Smaller but equally fine amethysts occur in Delaware County, Pennsylvania, Maine, and North Carolina. Oriental amethyst is a purple variety of sapphire, far more rare and valuable than the ordinary amethyst.

Agates are usually formed by the deposit of silica, with more or less of coloring oxides, in the cavities of igneous rocks. When the rock disintegrates, they fall out as hard nodules, and are then found on the surface, or frequently strewn along shores, beaches, and the beds of streams. These agate pebbles are abundant on the shore of Lake Superior and on the beach at Pescardo, Cal., and are gathered as souvenirs and to some extent cut for local jewelry. Externally they are rough and of little beauty, their veined structure and colors only appearing on breaking them, and still more upon polishing. They are made into seals, rings, pencils, handles for swords, knives and forks, mortars for grinding chemicals, bearings for fine balances, beads, studs, earrings, trinkets, match boxes, and many other objects.

A peculiar feature of all these agates and chalcedonies is their power of absorbing coloring matters under certain conditions, and by this means all manner of highly colored varieties are artificially produced by skillful treatment of the stone. Most of the deep red carnelians and sards are thus prepared by burning from pale or dull colored chalcedony, and all the black agate, which has now quite replaced jet in mourning jewelry, is so prepared. In the banded varieties some of the bands are more absorbent than others, and thus the highly colored black and white onyx and red and white sardonyx are produced, and most of the richly tinted variegated agates used for ornamental work. Picture agates is the name given to quaint markings resembling human forms or like objects. The famous Madonna agate in the Vienna collection has thousands of peasant visitors annually.

Moss agate has been much less used during the past twenty years than formerly, the annual sales not exceeding $1,000. Since the recent use in cheap jewelry of the Chinese natural green and artificially colored red and yellow moss agate the sale of the American has greatly fallen off. At Hartville, Wyo., large masses of moss agate weighing from forty to fifty pounds each were recently found in limestone rock. When cut into translucent slabs they show the magnificent black dendritic or mosslike markings in a most striking manner. Some table tops of this elegant material were exhibited in the Wyoming section of the Mining building at the World's Columbian Exposition. The finest instructive collection of agate known is the wonderful series presented to the Harvard Mineralogical cabinet by Dr. W. S. Bigelow, of Boston. Ruskin wrote upon and presented a fine series of agates to the British Museum.

If chalcedony is boiled in a solution of molasses and water, blood and water, or sugar and water, until it has absorbed a quantity of the solution, and is then again boiled in sulphuric acid, the transparent hydrocarbon is changed to a charcoal-like substance, and black onyx is produced. When white bands alternate with the chalcedony they are impenetrable to the coloring, and appear clearer and brighter. Black onyx has now almost entirely superseded jet.

The yellow variety is made by first putting the stones in a honey solution, then in a solution of chromate of lead for several days. Placed for a few weeks in hydrochloric acid, kept at a moderate heat, a beautiful clear yellow color is given to the streaks that were before a dirty brown. This is also erroneously called golden opal. Stones of a reddish hue are greatly improved in brilliancy of color by first thoroughly drying them for weeks in ovens, then dipping them in sulphuric acid, heating to full red heat, and afterward slowly cooling them. The changes that take place in both these processes are upon the oxide of iron which is the coloring matter.

Modern chemistry has wrought great changes in agate coloring, as in other arts, a secret process having been discovered by which chalcedony of any single color can be made to assume any two or more colors, so that an onyx of any shape or variety of colors can be made. If a sunken center of another color is required, it can be made so that the figure, when cut out, remains in a hollow, forming a cameo intaglio. In this manner the fine cutting of the cameo is protected. A white figure may be made in a black stone, a red figure in a brown stone, or a white one in a red stone. By this process the entire stone is first changed to the color desired for the outer layer, then a cavity is cut in the top and a solution put into it, which alters it to the required color. It is this discovery that has made a formerly valuable onyx worth now only a nominal sum.

Agates are thus made to assume the onyx character, which is desired by the lapidary for the production of cameos and intaglios in imitation of the antique sculptured gems. In cameos the figures are in relief and of a different color from the ground. Intaglios are usually all of one color. In Persia inscriptions or devices are written on beads of carnelian and other forms of agate with carbonate of soda and other chemicals; they are then burnt, and the inscription appears white in contrast to the other color. The principal supply of agates for the last hundred years has come from Brazil and other South American countries, where the stone is mostly found by Germans, who leave Oldenburg for that purpose, and who persevere until they find it. Thence it is sent to Germany for cutting, chiefly to Oberstein and Idar. Every fortnight from five to ten tons of the rough material is sold in Idar at public auction, usually in assorted lots of 100 or 200 pounds. The industry yields to the district an annual net profit of half a million dollars, and good agate workmen are among the best paid laborers in Germany, earning from $1.50 to $2 per day.

A NEW DISCOVERY IN PHYSICS.

It has been announced, says the Electrical World, that Dr. P. Zeeman, of the Amsterdam University, while working at Leyden, discovered that the lines of a metallic spectrum are broadened when the source of light is in an intense magnetic field. The experiments of Dr. Zeeman were most rigorously and accurately conducted. Both emission and absorption spectra were examined with a large Rowland grating spectroscope, and the results were marked and certain. The meaning of the fact is clear to those versed in electro-optics, and, indeed, some such broadening had been predicted by several physicists and sought for by others. Dr. Lorentz, of Leyden, from theoretical considerations, ventured the prediction that the light at the edges of the broadened lines would be found to be polarized. This was completely verified by the experiments of Dr. Zeeman. The discovery will probably substantiate the hypothesis that radiation is due to the motion of electric charges, whether free or associated with the vibrating molecules of the luminous body. It has seemed more and more likely, as knowledge of ether physics has advanced, that radiation could not be excited by the motions of the inert molecules of matter, but must of necessity require their electrification. The new facts apparently demonstrate that this is true, and throw another ray of light upon the still obscure subject of the mechanism of radiation. Of course, the principle bearing of the discovery is upon the theory of light. It is a step toward more complete knowledge of the means by which the particles of a body at high temperature disturb the adjacent ether. It contains also the germs of conclusions regarding the nature of radiating and absorbing matter which may go far toward extending our knowledge of molecular and ether physics. There is little doubt that the solutions of the two mysteries—the nature of light and of electricity—are destined to be simultaneously attained. This discovery is probably the most important contribution to science since Roentgen's announcement of his new form of radiation. The fascinating field of speculation opened by each advance toward knowledge of the ultimate nature of electricity and radiation and the mechanism of the ether contains most alluring possibilities of discovery, and every step taken in such an advance is of the utmost importance to nearly every branch of science.

USEFULNESS OF THE SIMPLON TUNNEL.

The Popolo Romano has published, says The Engineer, in one of its interesting special articles on the leading interests of Italy, a summary of the advantages to be derived from the projected tunnel through the Simplon, both to Italy and to travelers to and from Italy and Europe at large. The following table shows the respective distances in kilometers from different parts of Italy to all Western Europe and England:

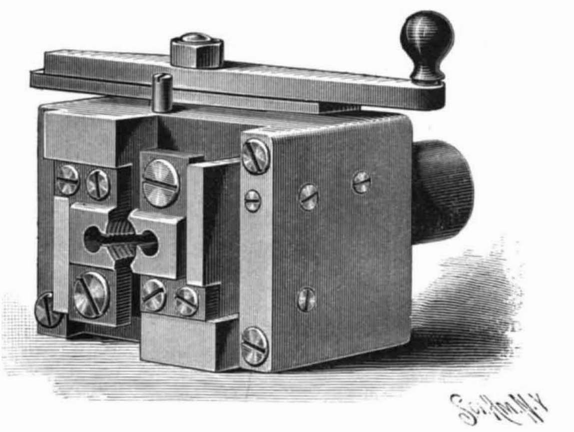
	Mont Cenis.	St. Gothard.	Simplon.
Milan to Paris	945	904	854
Milan to Boulogne	1239	1128	1108
Milan to Calais	1258	1105	1150
Piacenza to Paris	986	973	923
Piacenza to Boulogne	1269	1188	1155
Piacenza to Calais	1310	1185	1198
Venice to Paris	1208	1156	1103
Genoa to Paris	964	1047	946
Genoa to Calais	1261	1222	1243

But besides the shortening of distances, there is an advantage in the reduction of the height to be climbed, which is by the Mont Cenis route 1293 meters, by the St. Gothard 1155, and by the Simplon only 705. The heaviest gradient on the Simplon is—and that only for 19 kilometers—22 per 1000, while the heaviest on the St. Gothard reaches 26 and on the Mont Cenis 30. When the Neuchatel-Pontarlier line is shortened the real gain in the run from Milan to Paris will be 124 kilometers. There will be a gain also for Italy in the shortening of the distances from Genoa to the great industrial centers of Western Switzerland. The advantages for tourists coming from the West who desire to reach the north of Italy are considerable, to say nothing of the pleasure of a new route which passes through a section of the high Alps not hitherto touched by railway. According to the Times, the shortening of the distance will make the trip cheaper and compel the other lines to reduce their fares.

TO our way of thinking, says the Messenger, published at Hallstead, Pa., the SCIENTIFIC AMERICAN is the most instructive, interesting, and progressive publication of its class in the world.

AN IMPROVED DIE HEAD.

The die head shown in the illustration is constructed to approximate as closely as possible to a solid die, and possesses special advantages for makers of fine and exact work, particularly manufacturers of bicycle parts and fittings, etc. It is manufactured by Charles H. Besly & Company, fine tools and manufacturers' and machinists' hardware, Nos. 10 and 12 North Canal Street, Chicago, Ill. It has few moving parts, and such

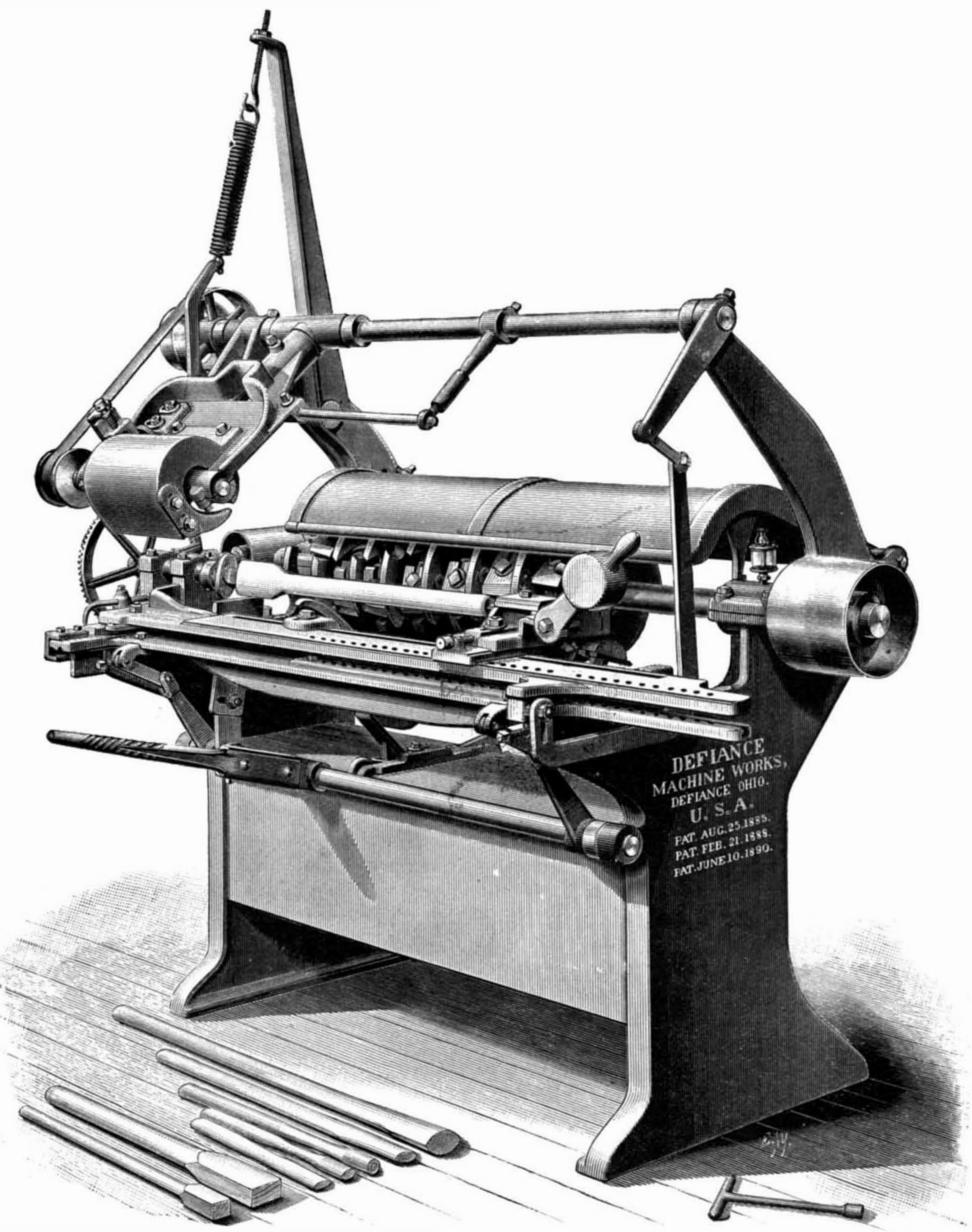


THE GARDNER NO. 94 DIE HEAD.

parts are very stiff. The sliding die carriers extend across the full length of the head, giving long wearing surfaces and great rigidity. The dies are closed by a taper pin forced into the back of the carrier. It will cut threads true to size, has few wearing parts, and will not clog with chips.

AN EFFICIENT WOODWORKING MACHINE.

From twenty-five hundred to three thousand pieces a day of finished spokes or handles can be made from the rough blanks, either sawed or rived, by the automatically operating machine shown in the illustration, which has an automatic swinging cutter head to square the head of the spoke and finish the eye ends of handles. The machine is made at the Defiance Machine Works, Defiance, Ohio, and has the necessary adjustments to turn common, Sarven, or sharp edged shapes, making either light hickory spokes or heavy spokes for wagon, truck, and artillery wheels up to 5 inches diameter and 42 inches long. The cylinder has cutter heads side by side on a 2¼ inch steel spindle to fill the length of turning, each head having three cutters with 3 inch face lapping over each other, and forming a continuous cutting edge to turn the full length at one cut. The table is made in two parts, gibbed, and slides on the frame in angle ways moved to and from the cutters by either hand or foot lever; the upper portion supporting the centers is pivoted to the lower half near the tail center by a steel pivot, in one of the several holes through the table, upon which it vibrates for oval turning. At the opposite end on the head center spindle a cast iron cam is placed of whatever shape desired to turn, the cam riding against an upright shoe extending up from the lower table, and being held snug against the shoe by a coiled spring. When the table is moved toward the cylinder to where the turning shall begin, an automatic feed slowly rotates the object to be turned, and the cam revolving against the shoe oscillates the upper table in a path corresponding with the shape of the cam. When the pivot is placed directly opposite the tail center, the machine will turn the material round at the tail center end with a gradual change in shape toward the opposite end, at which point the turning will agree with the shape of the cam. Long oval or irregular turning, when both ends are required to agree in shape, is turned with the vibrating table locked to the lower half, with the cam revolving against a shoe fastened to the frame, thus vibrating both tables alike at each end. The diameter of turning is regulated with graduating screws, having adjustments sufficient to turn work from ¼ inch to 6 inches diameter. The swinging cutter head advances and retreats from the work automatically, its position being governed by the movement of the table; it is brought down to its work at the same time the turning commences, and when the table is moved backward to remove the turned material from the centers, it is lifted out of the way by spring balance. Its action upon the turning is governed by a cam upon the live center spindle, and it will follow the path of either a square cam for squaring the head of spokes, or oval, oblong, hexagon or octagon shapes suited to finishing the eye end of handles, having the necessary adjustments to turn tapering in either direction, as well as the different diameters. The operation of this machine is very simple. The rough blank is placed between the centers and, when presented to the action of the cutters, revolves slowly and is turned its full length at one time, very smooth and to exact shape, requiring little, if any, finishing after leaving the machine. The material is placed into and removed from the machine without stopping.

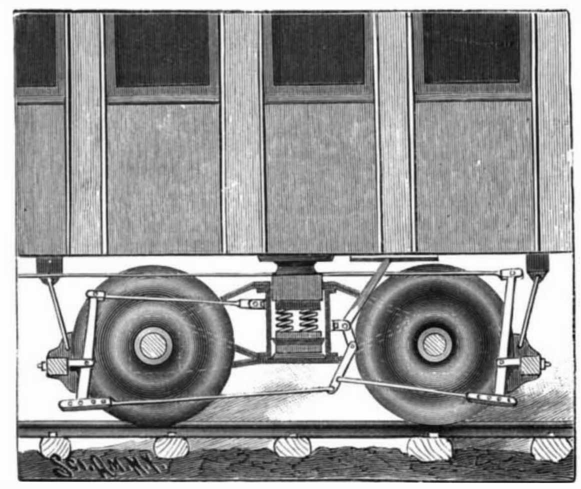


A COMBINED SPOKE AND HANDLE LATHE.

THE proportion of argon contained in the atmosphere is just as constant over all the world as the proportions of nitrogen and oxygen, says Prometheus. The average is 1·192 per cent (by volume), and the greatest deviations do not even amount to $\frac{1}{100}$ of the average.

AUTOMATIC SLACK ADJUSTER FOR CAR BRAKES.

To utilize the rise and fall of the car body, when the car is empty or depressed by its load, to automatically adjust the slack in the brake operating mechanism, Messrs. James B. and Harry E. Downing, of Arkansas City, Ark., have invented and patented the improvement represented in the accompanying illustration. The brake operating means shown are similar to those in common use, each brake beam being connected to a truck lever, and the upper end of the dead truck lever being connected to the truck frame, while the upper end of the live truck lever is connected by a rod to the air brake cylinder or the lever operated thereby. The bottoms of these levers are ordinarily connected by a single rod, but, according to this invention, the rod is divided into two sections, the inner ends of which are pivoted to an equalizing lever suspended upon a bell crank adjusting lever, which is pivoted upon a bracket fastened to the truck frame, and has its upper end bearing upon a plate on the under side of the car body. As the springs are depressed on the loading of the car, the upper end of the bell crank lever is forced down, changing the angle of the equalizing lever, and thus shortening the bottom rod. As the brake shoes bear on the wheels a little below their center, they fall away somewhat from the wheels when the car is loaded, as the levers have been heretofore connected, necessitating



DOWNINGS' SLACK ADJUSTER FOR CAR BRAKES.

adjustment by hand, but with this improvement the levers may be so proportioned as to maintain the slack constant in all positions of the car body.

The Gregorian Calendar.

The present time measurement that is now used by nearly all nations is the remodeled system adopted by Julius Cæsar in the year 46 B. C. There were 354, 360 and 365 days in the Greek year at different times. Under Numa the Roman year had 355 days, and there was so much variance between the civil and astronomical year that the autumn feasts were celebrated in the spring, and those of harvest in midwinter. Every second year an extra month called Mercedonius was added. This month had no certain length, but was arranged by the pontiffs as they saw fit, which naturally gave rise to corruption and fraud, interfering with the duration of office and the collection of debts. In order to restore the seasons to their proper months it was necessary for Cæsar to make the year in which he inaugurated the change contain 445 days. On the hypothesis that the astronomical year contained 364¼ days, he had each fourth year contain 366 days and the others 365. The extra day was added to the 24th of February, which was called Sexto-calendas, being the sixth before the calendo, or first of March, celebrated in honor of the expulsion of the kings. The additional day was placed next to this feast and known as Bis-sexto calendas.

But this year of Cæsar was too long by 11 minutes and 13·95 seconds, or about three days in 400 years, so that by A. D. 1582 the error amounted to ten days at least. To correct this miscalculation, Pope Gregory XIII ordered that October 5, 1582, should be known as October 15, 1582, and to prevent a recurrence of the error it was arranged that three intercalary days should be omitted in four centuries—that is, one in each centenary year except the fourth. Thus 1600 was a leap year; 1700 and 1800 were not. The passing year 1896 was a leap year, and under ordinary circumstances 1900 would be, but it will not be, in order to come under the rule of the Gregorian calendar. Therefore the years which have 366 days in are, first, those that are exactly divisible by 4 and not by 100, second, those that are exactly divisible by 400 and not by 4,000; hence the year 2,000 A. D. will be a leap year, and the only one in the series of the four centenary years.

All the Catholic countries adopted the Gregorian calendar as soon as the papal bull was issued, but it was not introduced into England and her colonies until 1752, the error then being 11 days. The dates previous to that change are referred to as old style.—Chicago Tribune.

NEY'S POCKET FIELD GLASS.

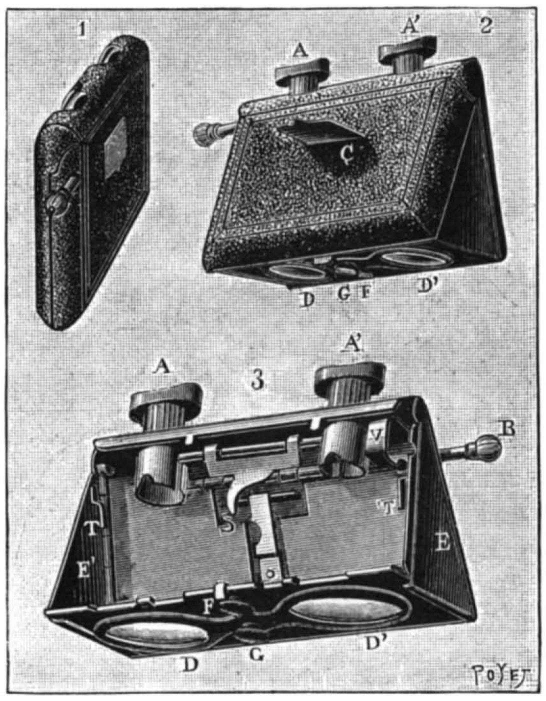
The instrument represented herewith (devised by Commandant Napoleon Ney) is not designed so much for the theater as for military maneuvers, in which the view of the officers must be applied to definite and remote points, and in which the impedimentum of the equipment cannot easily be increased by the weight of an ordinary field glass. It is especially adapted for the use of those who go touring upon the bicycle, in a horseless carriage, or even upon foot (and who always select the lightest and least cumbersome accessories that they can find), and also for use upon the race track.

The mounting of this instrument, which weighs but about eight ounces, consists almost entirely of aluminum. A few of the parts, such as the springs and those employed to give the instrument strength, are made of steel.

Fig. 1 represents the glass closed. It measures 4¾ inches in length, 3¼ in width, and ¾ inch in thickness. To the left, a button with a milled edge permits of moving the eye pieces so as to adapt the instrument to the vision of anybody. To the right there is a ring through which may be passed a chain or cord to prevent the apparatus from falling or getting lost. In the center, upon one of the flat sides, there is a metal escutcheon that may be raised at will and be grasped by the fingers in order to prevent the instrument from slipping. Finally, at the bottom, there is a push button for causing the apparatus to open instantaneously.

Fig. 2 shows the apparatus ready for use. The person employing it looks through the oculars, A and A', which are adapted to his sight through the button, B. The escutcheon, C, is here seen raised. The objectives, D and D', are in a plane exactly parallel with that of the oculars, and two lateral shutters, E and E', maintain the spacing of the two flat sides. In order to close the apparatus, it suffices to press upon the nickel plated button, F. The objective carrier will then yield to the pressure, and, at the same time that it lowers the lateral shutters, will cause the eye pieces to enter the case. A pressure upon the cover of the case will close the instrument precisely as we close a simple portemonnaie. Let us remark, besides, that if we unscrew the button, G, the two objectives will come off so that the glasses may be cleaned, or even be used for the reading of a map or document.

The details of the mechanism, shown in Fig. 3, are as ingenious as they are simple. The cover is here removed in order to show the interior. The objective carrier is held upright through two small spiral springs that rest upon the bottom of the case. If, pressing upon the button, F, we progressively lower this carrier, we shall see it reach, through its upper part, a small steel tappet, S, which forms part of the piece upon which the eye pieces move. This tappet, lowering under the thrust of the objective carrier, pushes the oculars backward. The carrier, continuing to lower, comes into contact, through its lateral parts, with two rods, T and T', riveted to the bottom of the shutters, and lowers them. The shutters, the objective carrier and the oculars thus enter the case. At this moment, the objective carrier, which covers the whole, is caught by a spring, V, so as to permit the cover of the apparatus to close. The operator may thus avoid pinching his fingers, without having to meddle with the spiral springs that tend constantly to raise the objective carrier. But a difficulty presented



NEY'S POCKET FIELD GLASS.

itself. Upon the case being reopened by the operator, it was necessary that the shutters and objective carrier should instantaneously resume their proper place; and yet the spring, V, the use of which is indispensable, as we have just seen, kept them fixed in their downward position. Commandant Ney, the inventor, and Mr. Huet, the manufacturer, have skillfully solved this little problem, the data of which are apparently so contradictory. They have rendered the spring, V, slightly convex, so that when the objective carrier engages with it, the cover of the apparatus, while closing it, rests upon this convex part and frees the carrier, which remains fastened only during the time necessary for the closing of the case. The objective carrier is, therefore, freed from the spring which retains it, and, controlled thereafter only by the two spiral springs, awaits a pressure upon the push button to cause it to stand erect and carry the shutters along with it.

Let us add to the credit of this instrument that it cannot get out of center, since, in its construction, there is used no screw that permits the lenses to play and present any of those disagreeable irisations that are common to so many field glasses.—La Nature.

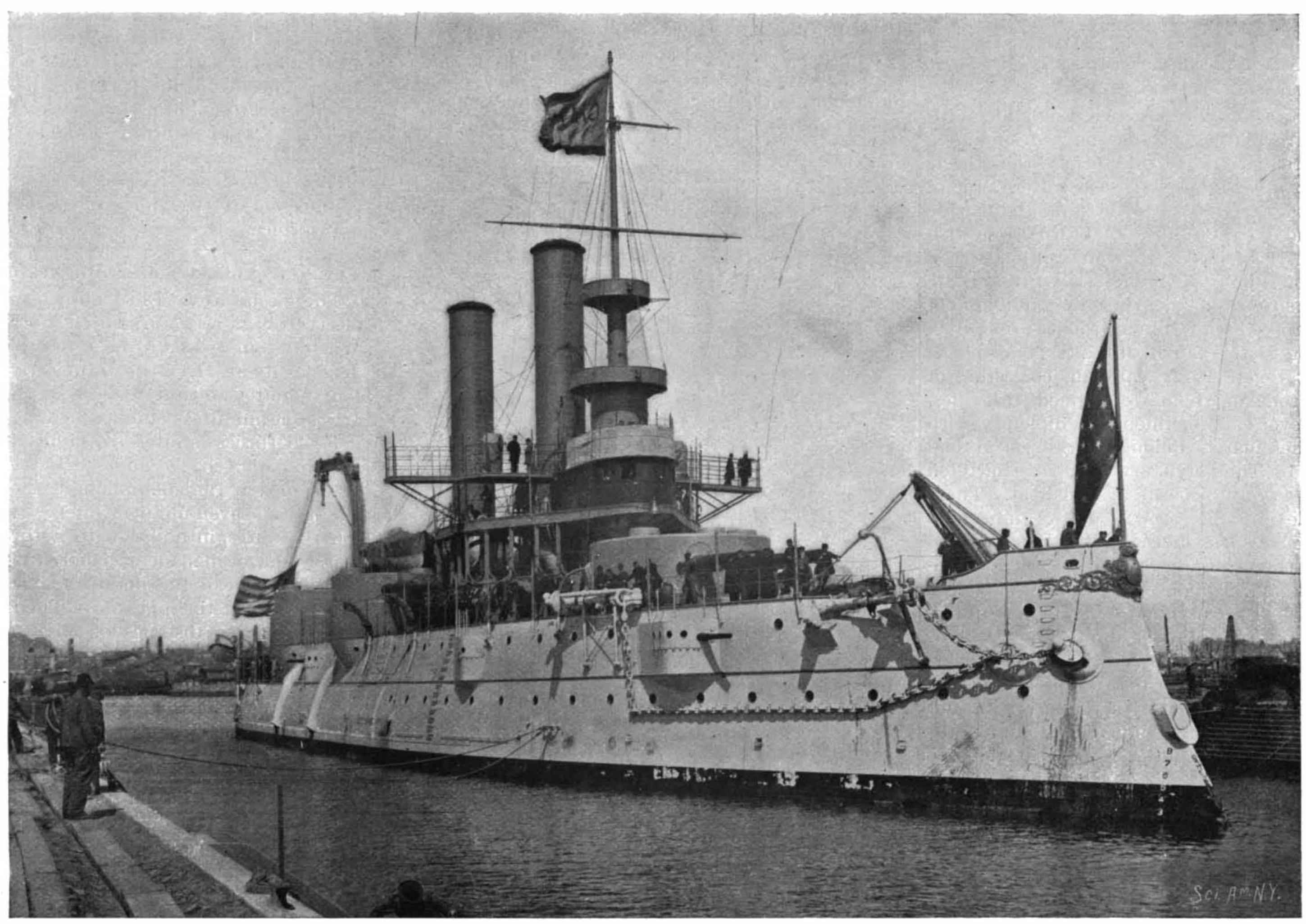
THE UNITED STATES FIRST-CLASS SEA-GOING BATTLESHIP IOWA.

We present a handsome engraving of the first modern first-class sea-going battleship built for the United States navy—the Iowa. It is reproduced from a photograph of this noble vessel which was taken immediately upon her arrival from Cramp's shipyard on the Delaware and just as she was floated into the new dry dock, No. 3, at the Brooklyn Navy Yard. Our readers will remember that we gave a full illustration and description of this dry dock in our issue of February 20, and from the record of its dimensions they will understand that it is fully equal to the task of accommodating a vessel of the size of the Iowa, in spite of the fact of her great draught and her loaded displacement of between 11,000 and 12,000 tons.

Our readers will doubtless observe that the Iowa bears a general resemblance to the Massachusetts and her class of ships, and they will ask why the Iowa should be designated as the first modern sea-going battleship of our navy. As a matter of fact, however, the Indiana, Massachusetts and Oregon are listed on the naval register as coast defense battleships, and, although they would be capable of crossing the Atlantic and giving a good account of themselves in a fight upon the high seas, they were not specifically designed for such service. Those elements of a battleship which make her a good sea boat in heavy weather have been somewhat sacrificed in these boats in favor of extremely heavy guns and massive armor plates, and it is this concentration of guns and armor which renders the Massachusetts and the vessels of her class the most powerful fighting ships in the world.

The design of the Iowa is based upon that of the Massachusetts, but with a view to giving her better seagoing qualities her freeboard has been raised about eight or nine feet, or about the height of one deck, from her bow back as far as the rear eight inch gun turrets. The forward pair of heavy guns with their turrets have been raised to the same extent, the axis of these guns being now about twenty-six feet above the water line at normal draught, and therefore well out of the reach of the heavy seas which would drown out the same pair of guns in the Massachusetts if she were steaming head to sea in heavy weather. The freeboard forward in the Iowa is about twenty feet and aft it is about twelve feet. The latter is about the greatest freeboard of the Massachusetts, which has a flush deck fore and aft for the whole length of the vessel.

The Iowa is 360 feet long, 72 feet in beam, and she has a displacement loaded of 11,410 tons. Three thousand tons of the weight is devoted to armor, which ranges in thickness from two and three-quarters inches to fifteen inches. The vitals of the ship are covered by a flat armor deck, which is two and three-quarters inches thick and reaches from side to side of the vessel, where it connects with belts of side armor fourteen inches in thickness which protect the vessel from penetration at the water line. Forward and aft of the ends of the side armor the steel deck is curved down to a connection with the stem and stern of the vessel. The



THE UNITED STATES FIRST-CLASS SEA-GOING BATTLESHIP IOWA IN THE NEW DRY DOCK No. 3 AT THE BROOKLYN NAVY YARD.

ends of the side armor are joined by an athwartship bulkhead which serves to protect the vitals from a raking fire.

The general disposition of the guns and turrets is similar to that of the Massachusetts. The main armament, which consists of four 12 inch guns, is located in two large turrets, located fore and aft on the axis of the ship, which are plated with fifteen inch Harveyized steel. Between the main turrets and well out on the sides of the ship are four smaller turrets, each of which contains two eight inch rifled guns, which discharge an armor-piercing shell weighing 250 pounds, that is capable of penetrating eight inches of steel at a distance of two miles. In addition to these guns there are six four inch rapid fire guns which discharge thirty-three pound shell with such rapidity that five of them can be kept in the air at the same time, and in addition to these the Iowa carries in her military tops and on the gun deck, and in various advantageous positions along the superstructure and upon the bridges, twenty six pounders, six one pounders, and four Gatlings, all of which are rapid fire guns, and are capable together of pouring out a perfect hail of small shot and shell upon the defenseless and lightly protected parts of an enemy.

The ship is driven by a set of twin screw, triple expansion engines of 11,000 horse power. The estimated speed of the ship is 16 knots an hour with the engines turning at a speed of 112 revolutions a minute. The normal coal supply will be 635 tons, with a total bunker capacity of 1,780 tons, and on the maximum allowance, at a 10 knot cruising speed, the Iowa could steam continuously for thirty-one days, covering a distance of 7,400 knots. The crew will consist of 444 men, and the increased size of the ship will allow of their being berthed and cared for with a degree of comfort which is not realized on the battleships with which we have compared her. A striking feature of this ship is the unusual height of the smoke stacks, which extend 100 feet above the grate bars. They were carried up to this height to secure a powerful natural draught, and reduce the forced draught air pressure in the stokehold.

The Iowa was approved by an act of Congress July 19, 1892, and the contract was awarded to William Cramp & Sons, of Philadelphia, Pa., the contract price for ship and machinery being $3,010,000. At the time that our photograph was taken this splendid ship had just come up from the shipyard of her builders, whose flag will be noticed flying at the masthead. The visit to the dry dock was made for the purpose of having her hull thoroughly scraped and painted and everything possible done to increase her speed at the official trial. Our readers will realize how thoroughly this work is done when they bear in mind that, by the terms of the contract, $25,000 is paid to her builders as a bonus for every quarter knot of speed which she realizes in excess of the contract requirements.

Exploration in Tanganyika.

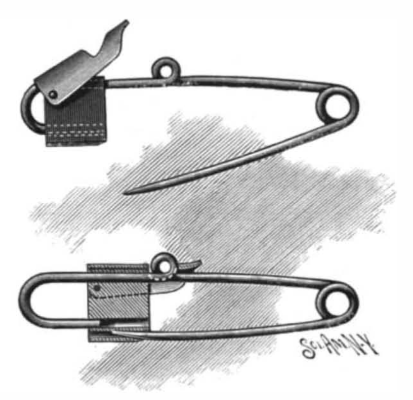
Mr. J. E. S. Moore has just reached England on his return from Central Africa, whither he went on an expedition, supported by the Royal Society, the objects of which were to investigate the fresh water fauna of Lake Tanganyika in relation to its supposed marine origin, and to find out the connection of that lake with the other great African lakes. In conversation with a representative of Reuter's Agency, says the Daily Graphic, Mr. Moore said: "Leaving England in September, 1895, I proceeded to Chindi, thence going by a British gun boat to the north of Lake Nyassa. At Karonga's I got together my caravan, consisting of about fifty men, some of whom were armed with rifles. There was, however, no likelihood of difficulty with the natives. I then marched along the Stevenson road to the south end of Tanganyika, where the Chartered Company placed at my disposal a steel boat. There was also available a number of Arab dhows and canoes which I used in my work on the lake. I commenced my researches in the beginning of April, 1896, and concluded my work on Tanganyika in September. I found the fauna of Tanganyika to be unique—unlike anything else anywhere—and as limited as peculiar. The jelly fish and shrimps were certainly of a marine type, while the geology of the district precluded the possibility of any connection with the sea in recent times. The water, which Livingstone found to be brackish, is now quite drinkable. All this seems to prove that the Tanganyika, part of the great rift valley running through this part of Africa, at one time had access to the sea, while it is perfectly clear that Lake Nyassa—some 246 miles to the southeast—apparently never had any marine connection. It is also a matter of interest that the fauna of Tanganyika is not only marine, but of a very peculiar and primitive type, and it is quite reasonable to suppose that the characteristics of the fauna are connected with the remote geological connection of the lake with the sea."

Asked regarding the condition of affairs in that part of Africa, Mr. Moore said:

"The so-called Stevenson road does not exist. There is not even a track beyond a point some twenty miles north of Lake Nyassa. But the Chartered Company's officers are now doing excellent work there. The forest is being cleared and good roads are being constructed across the high plateau. Captain Livingstone, who was constructing roads and administering the company's district at Sumbu, has, I have heard, just died. Dr. Watson was representing the company at Rhodesia on Lake Nweru, and Mr. Marshall was at Abercorn. Under these officials the development of that part of the country was proceeding satisfactorily. The British Central African protectorate officials were working from their end, and shortly their roads will connect with those to the northwest. In a very short time there will be a good wide road connecting the two great African lakes."

CHILTON'S SAFETY PIN.

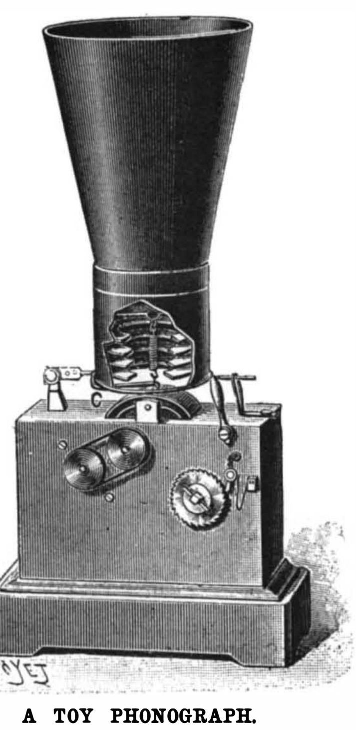
A safety pin which will not become loosened by the pressure of the fabric, and which may be readily fastened and unfastened when not within view, is shown in the accompanying engraving, and has been patented by Mrs. Annie H. Chilton, of the Colonnade Hotel, Philadelphia, Pa. One of the figures shows the pin open, with its locking slide moved back, while in the other figure the pin is closed and the locking slide is shown in section. Sliding freely on the back portion of the pin is a locking keeper or slide, which has in its lower edge a socket to receive the point of the pin, while to the upper edge of the keeper is pivoted a locking latch in which is a cut-away portion to receive a loop projection on the body of the pin. With this device the point of the pin is perfectly housed and the keeper positively locked to prevent it from being accidentally forced back.



A TOY PHONOGRAPH.

Although, in order to instruct children, it is well enough to make them read a description of great scientific inventions, such as the telegraph, telephone, phonograph, etc., it is certainly preferable to put these different instruments into their hands in order to permit them to learn how they operate.

Very simple apparatus capable of giving children general ideas as to the telegraph and telephone have been devised and sold at very low prices, but such an advantage has not hitherto existed for the phonograph. This want has, fortunately, just been supplied. Thanks to an ingenious instrument, which is very easily manipulated and of relatively low price, children will be able in the future to assure themselves that it is as



A TOY PHONOGRAPH.

easy to obtain a reproduction of the human voice with the phonograph as it is that of a piece of music by means of a mechanical piano. So this is one of the playthings that has met with the most success this year.

The principle upon which the construction of this phonograph is based is the same as that of the Edison apparatus. It is the transmission to a disk of the vibrations that correspond to certain sounds. For registering a sound in the Edison phonograph, a point connected with a plate in front of which the speaking is done traces upon a revolving cylinder moving longitudinally a series of lines, the depth and length of which depend upon the vibrations to which the plate is submitted.

It results inversely that when the cylinder is displaced the point with which it is in contact transmits to the plate, and then to the ears of the auditors, the sounds due to the vibrations to which the plate has previously been submitted. In order that such apparatus may be placed in the hands of children, it is necessary to take care not to have them of too fragile construction. The principal difficulty resides in the selection for the cylinders of some other material than wax, the wear of which is too rapid. Celluloid has been found good for this purpose.

These cylinders have an orifice in the center into which passes the rod that holds them in place, and a rotary motion is given them by a clockwork movement that is wound up with a key.—L'Illustration.

New Methods of Distinguishing Real from Apparent Death.

Two new methods of distinguishing real from apparent death are described and advocated by Dr. Séberin Icard in a book, just published in Paris, entitled "La Mort Réelle et la Mort Apparente." They are thus described in a brief review in the British Medical Journal, January 9:

"One method consists in the hypodermic or intravenous injection of certain substances, and subsequently ascertaining whether these substances have been dispersed throughout the system. If they have, then the circulation persists and life continues, although the beating of the heart may not be detected by auscultation. Among the substances recommended for injection are fluorescein, sodium iodid, lithium iodid, and potassium ferrocyanid. Preference is given to fluorescein, 1 gramme [15½ grains] of which is dissolved with an equal weight of sodium carbonate in 8 cubic centimeters [½ cubic inch] of water, and the whole quantity is then injected subcutaneously. If the circulation is persisting, the skin and mucous membranes after a very few minutes assume a yellowish-green color; about twenty minutes after injection the portion of the eye within the iris assumes a green color, from penetration of the fluorescein into the vitreous and aqueous humors, and in the blood the fluorescein may be detected by the following method: One or two threads of cotton are passed under the skin in a similar manner to a seton, and, when saturated with blood, are transferred to a test tube and boiled with a little water. As the liquid clears, the green color of the fluorescein becomes evident, if that body had been absorbed into the blood. It is stated that the injection of this quantity of fluorescein is unattended with danger, supposing the person to be alive.

"The second method for the distinction of real from apparent death consists in picking up a fold of the skin, and powerfully compressing it with a pair of artery forceps. If the skin does not completely settle down, and if the fine furrows produced by the teeth of the forceps continue indefinitely, then death has occurred; whereas, if the circulation is continuing, the fold and the marks of the teeth of the forceps disappear. Moreover, if death has occurred, the portion of skin compressed by the forceps assumes a parchment-like appearance."

The New York-Washington Train Record Broken.

The special Royal Blue train on which Vice President elect Hobart rode on March 2, from Jersey City to Washington, proved to be a record breaker. Leaving Jersey City at 11:15, the train arrived at the Twenty-fourth and Chestnut Streets station, Philadelphia, at 12:56, one minute behind schedule time, having been delayed three minutes at Trenton Junction to take aboard Gov. Griggs and party. Another delay was occasioned at Philadelphia, and the train pulled out of the station seven minutes late.

Six minutes, in addition to a three minute stop for water, had been made up before the train pulled out of the belt tunnel in Baltimore and it started for Washington one minute behind time. The run into the capital city station, a distance of forty miles, was made in thirty-six minutes, the fastest ever made over the division. The train arrived in Washington at 3:23, seven minutes ahead of time.

The total running time between Jersey City and Washington was four hours and eight minutes. Deducting nineteen minutes for stops and unavoidable delays, the actual running time for the 230 miles was 229 minutes.

There were several spurts made during the trip. The first fifty-seven miles out of Philadelphia were made in 56 minutes. From Aberdeen to Bay View, 22·7 miles, the run was made in 22 minutes. The average running time between Baltimore and Washington, allowing for slackened speed while within the limits of the two cities, is figured at 67 miles an hour. Eight and one-tenth miles of this distance was run in six minutes, an average of 81 miles an hour. Between Laurel and Washington, 18·7 miles, an average of 75 miles was sustained, the time occupied in covering the distance being fifteen minutes. The previous record from New York to Washington was 4 hours and 17 minutes.

Correspondence.

Cast Iron Field for Motor 641.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in the notes and queries of the SCIENTIFIC AMERICAN that many readers ask if the motor No. 641 would work with a cast field. I have made the motor No. 641 with a cast field and a drum armature with a two layer winding. I also made a copper bar commutator. The motor works fine and has lots of power. I advise any one not to make it for a dynamo. I would advise them to make a dynamo two-thirds the size of the dynamo in the SUPPLEMENT No. 600, as it is a good size for experiments generally, and will be found to work satisfactorily. ROY A. CRIHFIELD.

Lincoln, Neb.

[The cast iron fields will answer for a motor, the all important point being that the armature core shall be laminated. One object of the thin band construction was to avoid the necessity of calling upon the foundry for special castings—to give a design for a home-made motor.—ED.]

The Utilization of Water Power by Electric Transmission.

BY WILLIAM BAXTER, JR.

Every one who is familiar, in a general way, with the operation of electric currents realizes that they afford a means for the transmission of power over great distances at a moderate expense, and therefore believes that eventually, through this agency, every water power of any magnitude will be made available. There are very few, however, who do not labor under the impression that this phase of electric development is still in the experimental stage. The only work in the line of water power transmission that has come prominently before the public is that of the Niagara enterprise. This has attracted worldwide attention, owing to the magnitude of the power available, the general belief being that in the course of time the energy supplied from that source will be counted by the hundreds of thousands, if not by the millions, of horse power. This undertaking is generally looked upon as an experiment, a sort of crucial test, that will determine whether electric transmission can be made successful with our present knowledge of the science or whether we shall have to wait until some time in the future when, by further development, the barriers that block the way to the attainment of our ends may be removed. Such impressions, however, are entirely wrong; the experimental stage of long distance power transmission has been passed, and at the present time the manufacture of machinery for this branch of the electrical industry is of as much importance, if not more, than any other branch, and the indications are that in the very near future it will become as important as all the others combined.

It may prove a surprise to many to learn that work in this line has been carried on, more or less extensively, since 1892. In that year one of the large electric manufacturing companies installed about fifteen thousand horse power of water power transmission apparatus. Last year the business of the same concern, in this line, was about sixty thousand horse power.

One of the first installations of magnitude was that of the Hartford Electric Light Company, which was commenced in 1892. The capacity of this plant is over 1,500 horse power, and the power is transmitted over a distance of about eleven miles. Among the large plants installed since that time may be mentioned one at Sacramento, Cal., which has a capacity of nearly 11,000 horse power; one at Plezer, S. C., of 7,600 horse power; Salt Lake City, about 7,000 horse power; Columbia, S. C., 4,230 horse power; Bakersfield, Cal., 3,420 horse power; Montreal, 12,000 horse power; Ogden, Utah, 11,000 horse power; Hookset, N. H., 3,000 horse power; Fresno, Cal., 2,300 horse power; Portland, Ore., 4,600 horse power; Minneapolis, Minn., 12,000 horse power, and several others.

These plants, as will be noticed, are all of large capacity, and represent in the aggregate nearly 80,000 horse power. There are a great many smaller installations, ranging from 2,000 down to as low as 50 or 60 horse power, thus showing that this form of power transmission is not limited to large units. The total number of water power plants now in operation, or in process of construction, cannot be ascertained with accuracy, but it is known that there are over two hundred light, power, and electric railway stations that depend exclusively upon this source of energy, and many others in which it is used in connection with steam engines. Water powers, as is well known, are not uniform; the flow of water varies at different periods of the year, and in some instances the variation between the maximum and the minimum capacity may be as much as 60 or 70 per cent. When the minimum power is sufficient to meet the requirements, a water plant alone is used, but in other cases it is supplemented by a steam plant, the latter being brought into requisition as fast as the water supply falls short. In some cases even the maximum capacity of the water power is not sufficient to meet the requirements, so that at all periods of the year steam has to be used. In these composite plants the total capacity of the water power at all seasons of the year is fully utilized, and the steam engines are used to supply only the difference between the energy thus obtained and the total amount required.

What has been accomplished so far demonstrates conclusively the feasibility of transmitting power over long distances on a commercially successful basis. At Sacramento, Cal., the distance of transmission is 22 miles; at Fresno, Cal., it is 35 miles; at Ogden, Utah, 36 miles. The distance from Niagara to Buffalo is 21 miles, which is less than the distance in either of the three cases above cited; therefore, there can be no doubt as to the success of transmission in the latter case, so far as the engineering features are concerned.

Heretofore there has been some doubt in the minds of engineers as to the practicability of long distance transmission, because it was doubted whether an electrical pressure sufficiently high to reduce the cost of copper in the conducting lines could be used successfully, but it has been shown by the actual operation of the installations already named that there is no difficulty to be encountered in this direction. In a large number of cases the pressure of the line current is 10,000 volts, and in Ogden, Utah, 15,000 will be used. With such pressures, the cost of transmission lines can be reduced to a point well within permissible limits, for distances as great as twenty-five miles, and where the price of fuel is high enough to increase the cost of steam power to a point that will justify a greater loss of energy in the line, the distance can be considerably increased. There is no reason to believe that in a pressure of ten or fifteen thousand volts we have reached the limit. If this can be handled successfully now, it is more than probable that before long twice as much will be within the possible range, and such an increase in pressure simply means that the thirty and thirty-five miles over which power is now transmitted will then be increased to sixty or seventy miles.

The future development along the line of water power transmission promises to be very great, from the fact that there is so much power to transmit. According to a section of the United States census of 1880, devoted to the water powers of the United States, the energy of this kind available runs up into the millions of horse power. Some fifty-odd power sites that are described have a combined capacity of over 500,000 horse power.

The development for some years to come will no doubt be in the direction of utilizing large water powers, but eventually, as the cost of apparatus and the installation is reduced, smaller ones will be taken up, and perhaps the day is not far off when every farmer who has a power of ten or more horse power on his premises will harness it, and do with it the work now performed by animals or agricultural steam engines.

Railways in Chile.

Although Chile is still deficient in the important matter of easy, rapid, and economical means of communication and transport within her own borders, this question, which is of such great importance, does not appear to have been ignored by the authorities, says the Railway Review. According to a recent Chilean report, since the first railway was inaugurated, in 1851, iron roads have multiplied, and railroad extension has progressed to such a degree that the union of Valparaiso and Puerto Monti by rail has been brought within a readily measurable distance of time.

The great trunk line has prolonged from time to time until it has been found necessary to divide it, for the purpose of administration, into three sections, to which there will probably be added, at no very distant day, a fourth. The first section comprises the line from Valparaiso to Santiago, and includes the branch from Las Vegas to Los Andes; the second comprises the line from Santiago to Talca, and includes the Tinguiririca and Palmilla branch; while the third comprises the line from Talca to Victoria, and includes the Angeles Traignen and Talcahuano ramifications. The total length of the first section is 228 kilometers (kilometer= 0·621 of a mile), of the second 296, and of the third 582, or a total of 1,106 kilometers.

At the end of 1895 the condition of the state lines in course of construction was officially reported to be as follows: Vilos, Illapel, and Salamanca line, of 102 kilometers in length, has suffered many delays, but the Calibolen tunnel is finished as far as piercing is concerned. Work was also suspended for some time on the Ovalle and San Marcos line, but operations were recommenced on the Ovalle to Paloma section, and it has been finished.

The Calera to Cabildo line is open for traffic to Palos Quemados. A considerable portion of the Talca and Constitucion line, the total length of which is 92 kilometers, is open for traffic. The Coihue to Mulchen line, 42 kilometers, has been completed. The Temuco to Pitrufquen line is being rapidly pushed forward, and the Pichi Ropulli line has been opened for traffic. Finally, surveys have been completed for several other lines.

Science Notes.

M. Maurice de Thierry presented a memoir to the Paris Academy of Sciences regarding the estimation of atmospheric ozone on Mont Blanc. The experiments were made at Chamounix and the Grands Mulets, and the amounts found were two to four times greater than at the Observatory of Montsouris. The tests were made by noting the oxidizing action of an alkaline arsenite in the presence of potassium iodide.

The action of carbon monoxide and dioxide on aluminum has been recently described by MM. Guntz and Masson before the Paris Academy of Sciences, says The Engineer. At a high temperature, in the presence of a little iodide or chloride of aluminum, aluminum is readily burned in a current of either CO or CO_2. With the former the reaction is $6Al+3CO=Al_2O_3+C_3Al_4$, the aluminum carbide giving practically pure methane on boiling with water. Carbon dioxide gives the same product.

The relation between the flow of air and the pressure it exerts on surfaces exposed to its action is expressed by the formula $P = c\,v^2$, where P represents the pressure in pounds per square foot, v is the velocity in miles per hour, and c is a constant affected by temperature and barometric pressure, which is determined by experiment. The value attached to the constant c covers a wide range, but the United States Weather Bureau has adopted the value $c = 0{\cdot}0040$, making the formula $P = 0{\cdot}004\ v^2$. A generally accepted value is 0·005.

Recent experiments on argon by Messrs. Trowbridge and Richards show that argon, at low pressures, fluoresces (blue) under the action of the Hertzian waves. The spectrum given by the gas depends, says the Electrical Engineer, upon the voltage of the discharge through it. An oscillatory discharge will give the blue of high voltage spectrum; but if there is self-induction in the circuit, this is converted into the lower or red spectrum. It is suggested by the investigators that it might be possible to use an argon discharge tube as an inductometer.

In a paper on the preservatives of pharmacopœial preparations, by Mr. Martindale, read before the Pharmaceutical Society, it was stated that alcohol is not a germicide. When present to the extent of 20 per cent by volume of absolute alcohol, it has an inhibitory effect on the germination of most of the micro organisms occurring in aqueous solutions of vegetable and animal substances; but the germs propagate readily as soon as it evaporates. Salicylic acid is the preservative employed for the official solution of hydrochlorate of cocaine, which contains 1½ per mille of the acid, with 10 per cent of the cocaine salt. This solution, even if diluted with four times its volume of water, still keeps free from the fungoid growths to which cocaine solutions are so liable.

President David S. Jordan, of Leland Stanford Junior University, commissioner to investigate the condition of the fur seal, recommends, in his report to the Secretary of the Treasury, that the open season for the killing of females be abolished, to keep the Pribilof herd intact. He estimates the number of seals killed last summer as 440,000. About 27,000 pups died of starvation, and pelagic sealing caused the death of about 30,000. Since pelagic sealing began, more than 600,000 fur seals have been taken in the North Pacific and in Bering Sea, taking into account only those whose skins were brought to market. Many more were shot or speared, and lost. The number reported means the death of 400,000 females, the starving of 300,000 pups, and the destruction of 400,000 pups unborn.

It is said that 95 per cent of visual hallucinations in delirium tremens consist of snakes or worms, in one form or another, says the Electrical Review. Dr. Davis has been investigating the subject in the alcoholic wards of Bellevue Hospital with the opthalmoscope, and has brought out some interesting facts. In every one of the sixteen cases examined the blood vessels of the retina were found to be abnormal. Instead of being pale and almost invisible, as in their ordinary condition, they were dark—almost black—with congested blood. The blood vessels of the retina, which are so small and semitransparent in health that they are not projected into the field of vision, assume such a prominence that they are projected into the field of vision, and their movements seem like the twisting of snakes.

M. Henri Léon, in an essay on the saltness of sea water, gives in the Monthly Bulletin of the Biarritz Association the results of analyses of water from different seas, etc. Taking 1,000 grammes of water, the result showed in the Atlantic 32·657 grammes of saline matter, in the Mediterranean 43·735, in the Black Sea 17·663, in the Sea of Azov 118·795, and in the Caspian 62·942. Among the saline matter chloride of sodium varied considerably. The sea was found to be less salt near the poles than at the equator, and was more salt at a distance from land and where it was of great depth than near the land and shallow. The Mediterranean is the exception, which is explained by the comparatively few rivers that freshen its waters. Salt lakes are frequently more salt than the ocean, as, for instance, the Dead Sea, which is ten times salter than the Atlantic.

THE YERKES OBSERVATORY.

(Continued from first page.)

length of the instrument will be between 62 and 63 feet. This will be increased by several feet when the spectroscope is in place, and a dew cap about 7 feet long will project beyond the object glass. The image of the sun or moon formed in the focal plane will be nearly 7 inches in diameter.

The magnifying power of the telescope can be made by mere change of eyepiece to range of 200 to 4,000. The highest power will bring the moon, optically, to within about 60 miles of the astronomer's eye, but very much lower powers are used in practice, as more can be seen with them.

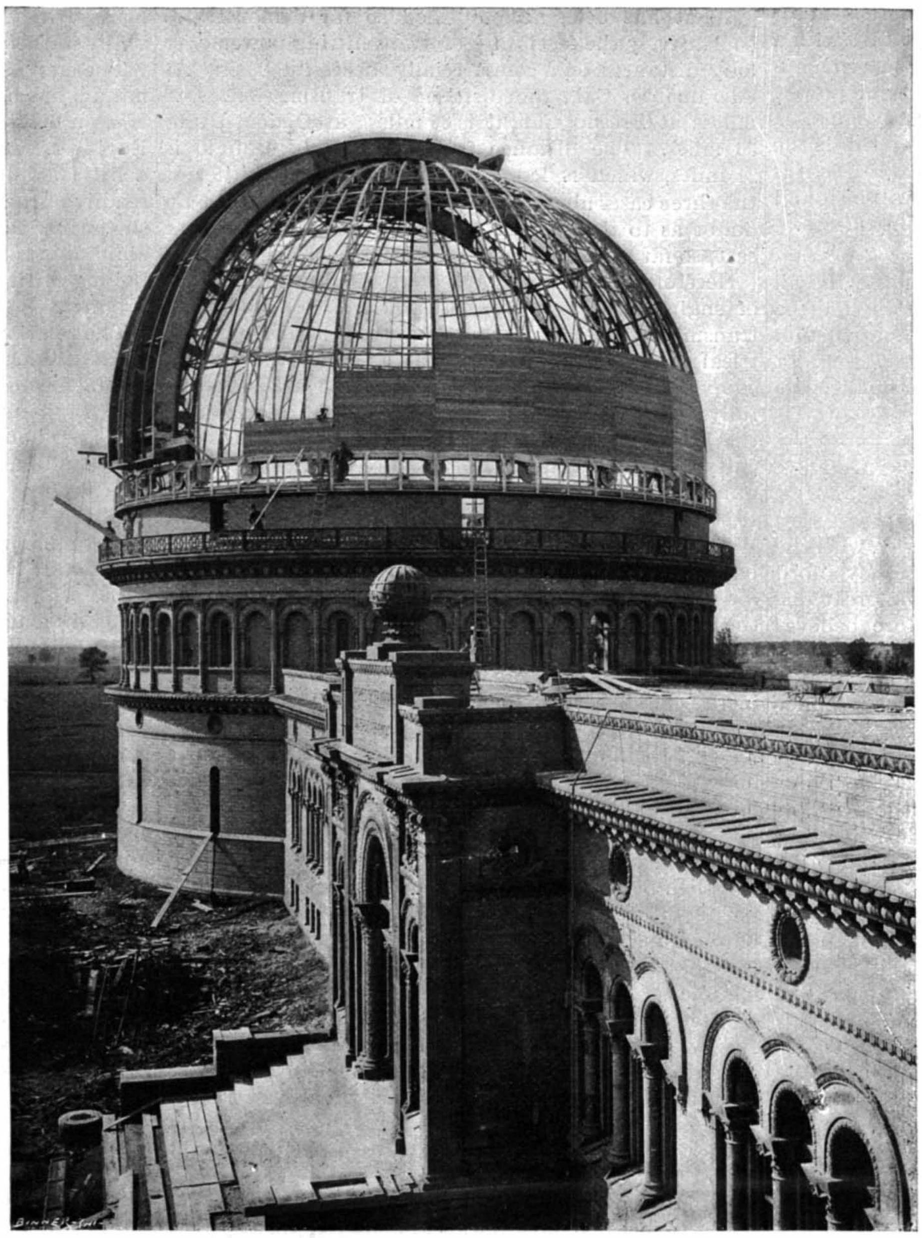
The Observatory building, of which we present (by courtesy of the Director) an engraving showing its present condition, is situated on the northern shore of Lake Geneva, about seventy-five miles to the northwest of Chicago, in an ideal rural region, free from the dust and smoke of cities and the tremors caused by traffic. It is one hundred and eighty feet above the water and stands in a tract of ground which was given especially for it. The site of the observatory includes about fifty acres of wooded land fronting on the lake. It is believed that the conditions will be favorable for the most delicate investigations in all branches of astronomy and astrophysics.*

The architect of the building was Henry Ives Cobb, whose Fisheries building at the Chicago Exposition attracted much attention. The building is in the form of a Roman cross, with three domes and a meridian room. The longer arm, running east and west, is about three hundred and thirty feet long. The great dome, in which is housed the big telescope, is situated at its western extremity and the meridian room is at the other end. The cross arm carries a smaller tower and dome at each end. The 12 inch telescope, which was formerly at the Kenwood Observatory, Chicago, has been set up in the northeast tower and has been in daily use. The other dome is not built as yet. In the southern dome a 16 inch telescope will eventually be placed. It is expected that a great deal of the minor work of the observatory can be conducted with these two instruments; for any work which can be done with a moderate sized instrument, can be accomplished much more readily and rapidly with a small telescope than with a large one, and Prof. Young aptly says that "an observatory equipped with one great telescope only is much like a warship with no rapid fire guns." Between the two small domes is the heliostat room, 104 feet long and 12 feet wide. A heliostat with 24 inch plane mirror will stand on a pier at the north end of the room under an iron roof which can be rolled away to the south.

The meridian room is designed to receive at some time a first-class meridian circle, but at present a small transit instrument is used. The room has double sheet iron walls with an intervening air space. The body of the building is divided through the center by a hallway extending from the meridian room to the tower which supports the great dome. On either side are offices, computing rooms, library, lecture room, two spectroscopic laboratories, photographic and chemical laboratories, galvanometer rooms, etc. In the basement is a dark room, an enlarging room, a concave grating room, with large concave grating spectroscope, constant temperature room, physical laboratory, optician's room, etc.

The instrument shop, which has been fitted up under the direction of Prof. Wadsworth, must be regarded as an extremely important adjunct in the observatory work. In this shop the various pieces of apparatus needed for the investigations of the observatory are constructed.

The optical laboratory is being fitted up by Mr. Ritchey, optician of the observatory. It might be reasonably supposed that this work was undertaken because of a lack of instrument makers, but this is not the case. American optical instrument makers are second to none. It is believed, however, that the best results can be obtained only when instruments of research are constructed under the immediate supervision of those who are to use them. Desirable changes in construction or design which become evident as the work progresses can, under these circumstances, be readily and inexpensively made, and it is believed that the instrument makers themselves will benefit by it in the end.



GREAT DOME OF YERKES OBSERVATORY, OCTOBER, 1896.

The power for working the motors of telescope dome, rising floor, and instrument shop, and electricity for lighting and steam for heating is all generated in a separate building at some little distance from the observatory proper, equipped by Mr. Yerkes with two 40-horse power Ideal engines, direct connected to Siemens-Halske dynamos.

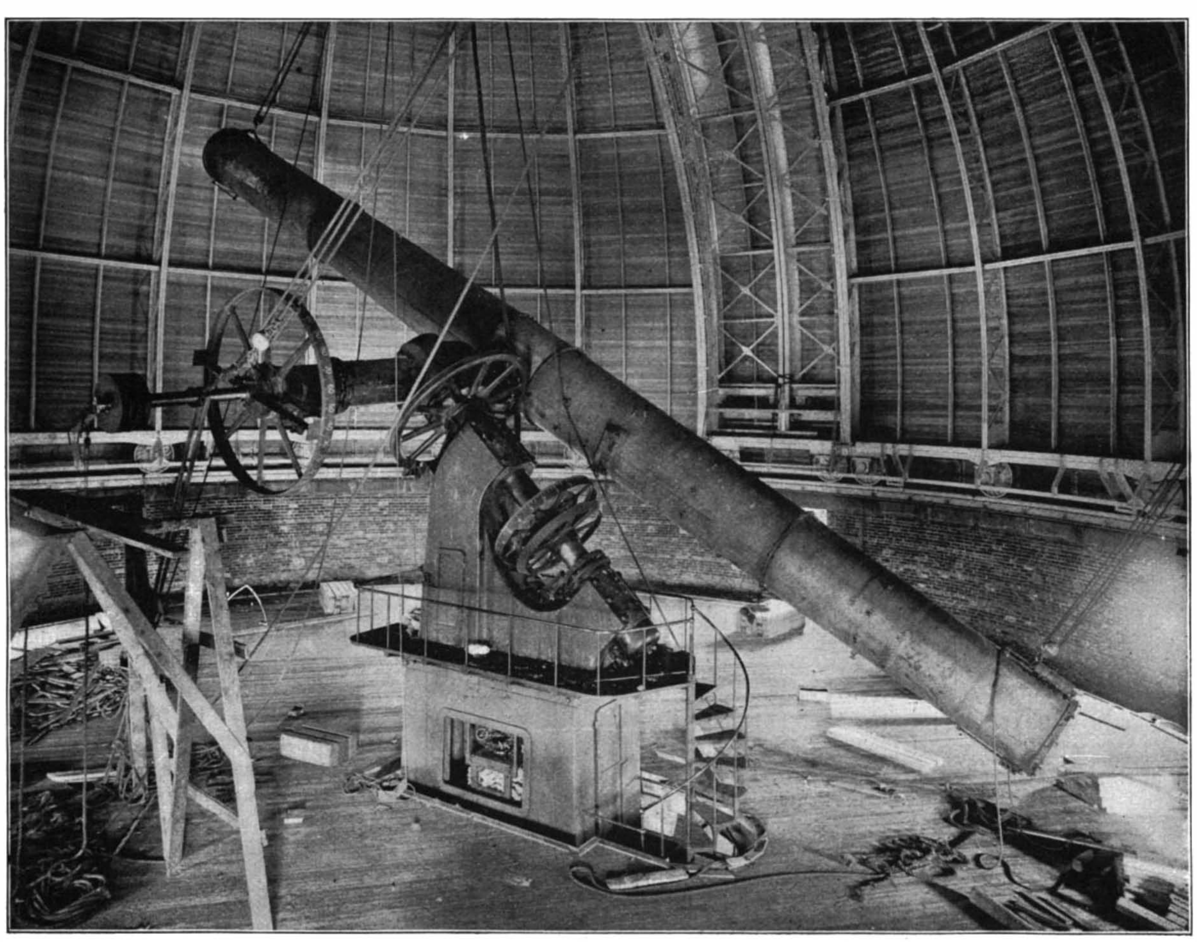
The telescope stands under the great dome of the observatory. The column and head, which are of cast iron, rise to a height of 43 feet and weigh 50 tons. A spiral staircase at the south side of the column leads to the clock room, which is in the upper section, and to the balcony which surrounds the head. The polar axis is made of steel, 15 inches in diameter, 13½ feet long, and weighs 3½ tons. The declination axis is of steel, 12 inches in diameter, 11½ feet long, and weighs 1½ tons. The tube, also of steel, is 64 feet long and 52 inches in diameter at the center, tapering toward the ends. Its weight is 6 tons, but it is so beautifully balanced that a pressure of twenty pounds would move it easily.

The driving clock is controlled by a double conical pendulum, mounted isochronously, and is kept wound automatically by an electric motor, and weighs 1½ tons. It is geared to the main driving wheel, 8 feet in diameter, which, when clamped to the polar axis, revolves it, together with the tube and all its accessories, a weight of 20 tons, in exact sidereal time.

All quick and slow motions and clamps, both in right ascension and declination, are operated electrically and also by hand, the electric motors, magnets, and illuminations being controlled from a switchboard placed within easy reach of the astronomer. The assistant astronomer also has full control of the quick motions in right ascension and declination from the balcony. The old style hand attachments for the slow motions are not entirely done away with, but are provided solely as a measure of precaution in case of disabling of the electrical plant or the breaking of a wire, electric motors being coupled directly to the different slow motion screws. Little now remains to be done to the mounting. The dome and rising floor are also finished, and in a short time the large object glass will be in place and the telescope will be ready to use for actual observations.

The attachments of the Yerkes telescopes will include: 1. A position micrometer by Warner & Swasey. 2. A solar spectrograph, for micrometrical and photographic investigations of the spectra of solar phenomena. 3. A spectro-heliograph, for photographing the solar chromosphere, prominences and faculæ by monochromatic light. 4. A stellar spectrograph, for researches on the spectra and motions of stars, nebulæ, comets and planets.

One of our smaller engravings, for which we are indebted to the Astrophysical Journal, shows the process of erecting the declination axis of the Yerkes telescope. Our other en-



MOUNTING OF THE 40-INCH YERKES TELESCOPE, SHOWING RISING FLOOR.

* For a more detailed statement regarding the site of the observatory and the circumstances which influenced its selection see the Astrophysical Journal, March, 1897.

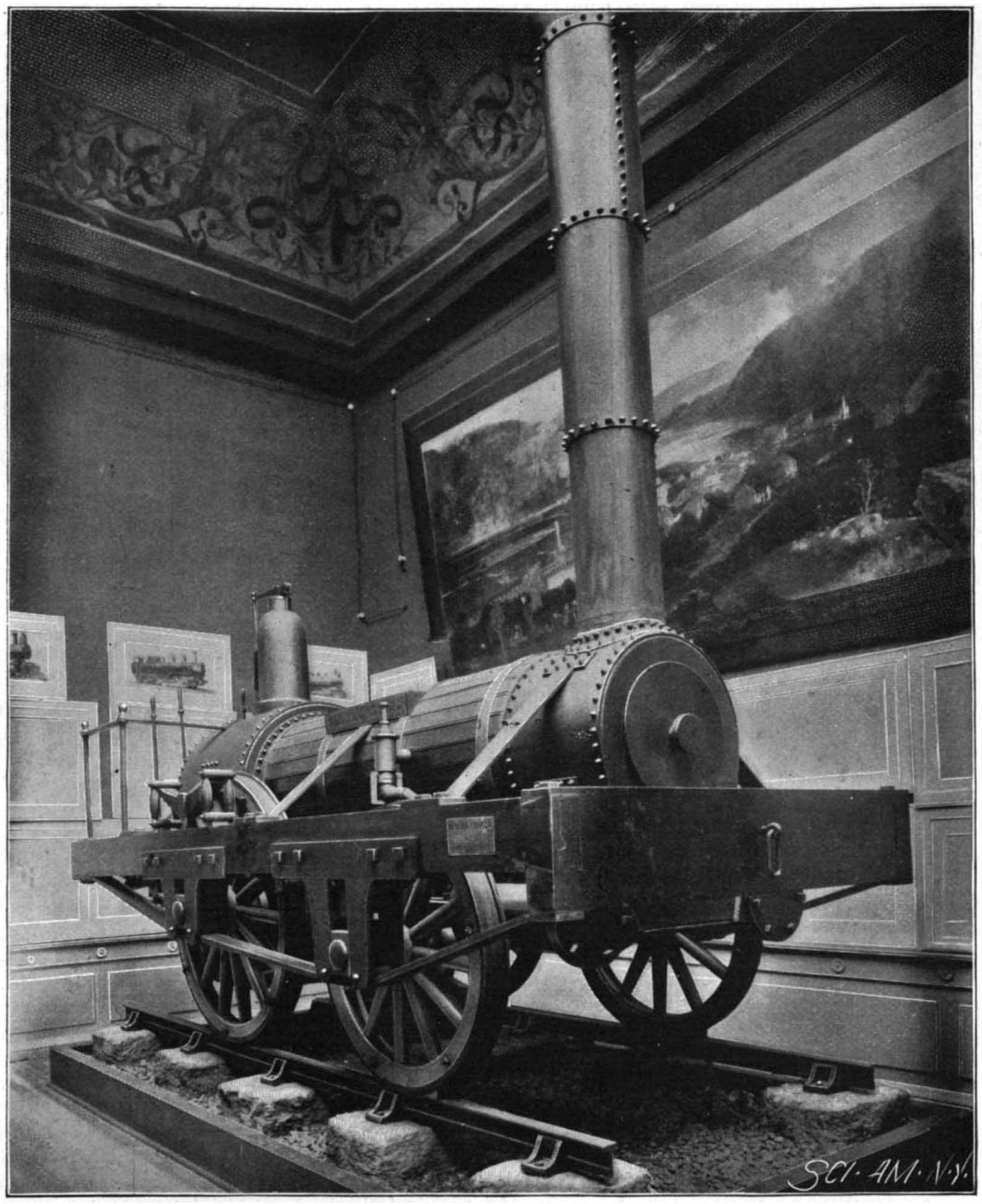


Fig. 1.—OLD IRONSIDES, BALDWIN'S FIRST LOCOMOTIVE—BUILT 1832.

graving shows the mounting of the telescope; the photograph was taken in November, 1896, and the rising floor is shown at its highest level. Our third small engraving shows the skeleton steel construction used in the dome. The great dome with its elevating floors is among the unique features of the observatory. The elevating floor of the Naval Observatory at Washington was designed and constructed in 1892 in a similar way to that of the Yerkes Observatory, except that the floor is operated by hydraulic rams instead of electrically, as is the case with the new observatory.

The great dome of the Yerkes Observatory, 90 feet in diameter and 60 feet high, was designed and constructed by Messrs. Warner & Swasey. The dome consists of a framework of steel girders covered with a sheathing of wood and tinned on the outside only; it weighs 140 tons and revolves on thirty-six wheels running upon a circular track of T rails built upon the masonry walls. The journals for the wheels are provided with antifriction bearings. The dome is revolved by means of an endless cable connected with the turning mechanism and operated by an electric motor.

The two shutters are 85 feet long, covering the opening, which extends from the horizon to a point 5 feet beyond the zenith. They are supported on tangential tracks at their extreme upper and lower ends, and run on wheels with anti-friction bearings. They are so easily adjusted that a direct pull of 72 lb. at the lower end moves the shutter its whole length, its position being maintained parallel with itself throughout the entire distance of motion by special mechanism. The shutters open from the center outward and work simultaneously.

The elevating floor, also designed and constructed by Messrs. Warner & Swasey, is 75 feet in diameter and weighs 37½ tons. The floor is circular in shape, and completely surrounds the telescope column, which is placed practically in its center. The floor is supported by four cables 90 degrees apart, and is carefully counterbalanced by weights running in four columns which serve as guides. The ropes for operating the floor also run in the same columns over sheaves placed at the top, the other end of each of the four ropes being wound around separate drums 4 feet in diameter, placed at the base of each of the columns. The drums are operated by worm gearing, and all four of the shafts which run the worms are operated from a single point by means of an electric motor, the arrangement of the drums and operating mechanism being such that the different positions of the elevating floor are always parallel to each other.

A balcony five feet wide surrounds the inside of the dome at the lowest position of the elevating floor, and another one 23 feet above it at its highest position, as shown in our engraving. When the telescope is directed to the zenith, the objective will be some seventy-five feet above the normal level of the floor.

The organization of the Yerkes Observatory is as follows: George E. Hale, director and astrophysicist; S. W. Burnham, astronomer; E. E. Barnard, astronomer; F. L. O. Wadsworth, astrophysicist; Ferdinand Ellerman, assistant; G. Willis Ritchey, optician.

When the great object glass is in position, it is certain that the observatory will become a place of pilgrimage for astronomers of all countries.

Sensationalism in science is greatly to be deplored, and it should be remembered that the instrument is but slightly larger than that of the Lick Observatory, and while it is certain that excellent work can be done with it in many departments of astronomy and astrophysics, it is not at all probable that discoveries of a sensational character will be made.

THE FIELD COLUMBIAN MUSEUM, CHICAGO.

The great Columbian Exposition of 1893, at Chicago, has left an enduring record in the practical benefits which it has brought to the world in general and to this country in particular. It served to point out in one great object lesson the unrivaled growth of the United States in everything that goes to make up the sum of modern civilization, and it brought to our shores the best products of the skill and genius of other nations. It served as a great assembly hall for the wise and gifted of all the earth, and during the months of that memorable summer the choicest minds of the old and new worlds met in the friendly discussion of the great, burning questions of art, science, and religion. These are facts that were so fully and eloquently recognized and declared at the time that it is a mere repetition of a well known truth to insist upon them now.

But apart from—or rather over and above—the unseen but none the less potent benefits which the great event left in its train, there stands to-day, at the northern end of Jackson Park, a magnificent memorial of the exhibition, which is a concrete evidence of the beauty and magnificence of its buildings and the unrivaled excellence of the exhibits which they contained. We refer to the classic structure known during the exposition as the Fine Arts building, but now bearing the name of the Field Columbian Museum.

The auctioneer's hammer and the great conflagration at the close of the fair swept away from the broad area of Jackson Park practically every building of note, leaving, as was fitting, the most substantial and architecturally the most choice of them all to stand as a permanent and adequate memorial to the grandeur which once spread out before its noble facade.

There is an impression abroad that the creation of a permanent museum in connection with the exposition was an afterthought, begotten in the closing hours of "the Fair." This is quite incorrect. As a matter of fact, the idea first took shape in 1890, when it was suggested by Prof. Putnam, of Cambridge, Mass., in a letter to the Chicago Tribune. The idea was fostered during 1891 by Director Goode, of the National Museum, and by the members of the foreign affairs committee of the exposition directory. To this committee, of which President Baker was chairman, the excellence of many of the departments of the museum, especially the anthropological and transportation departments, is due; purchases being

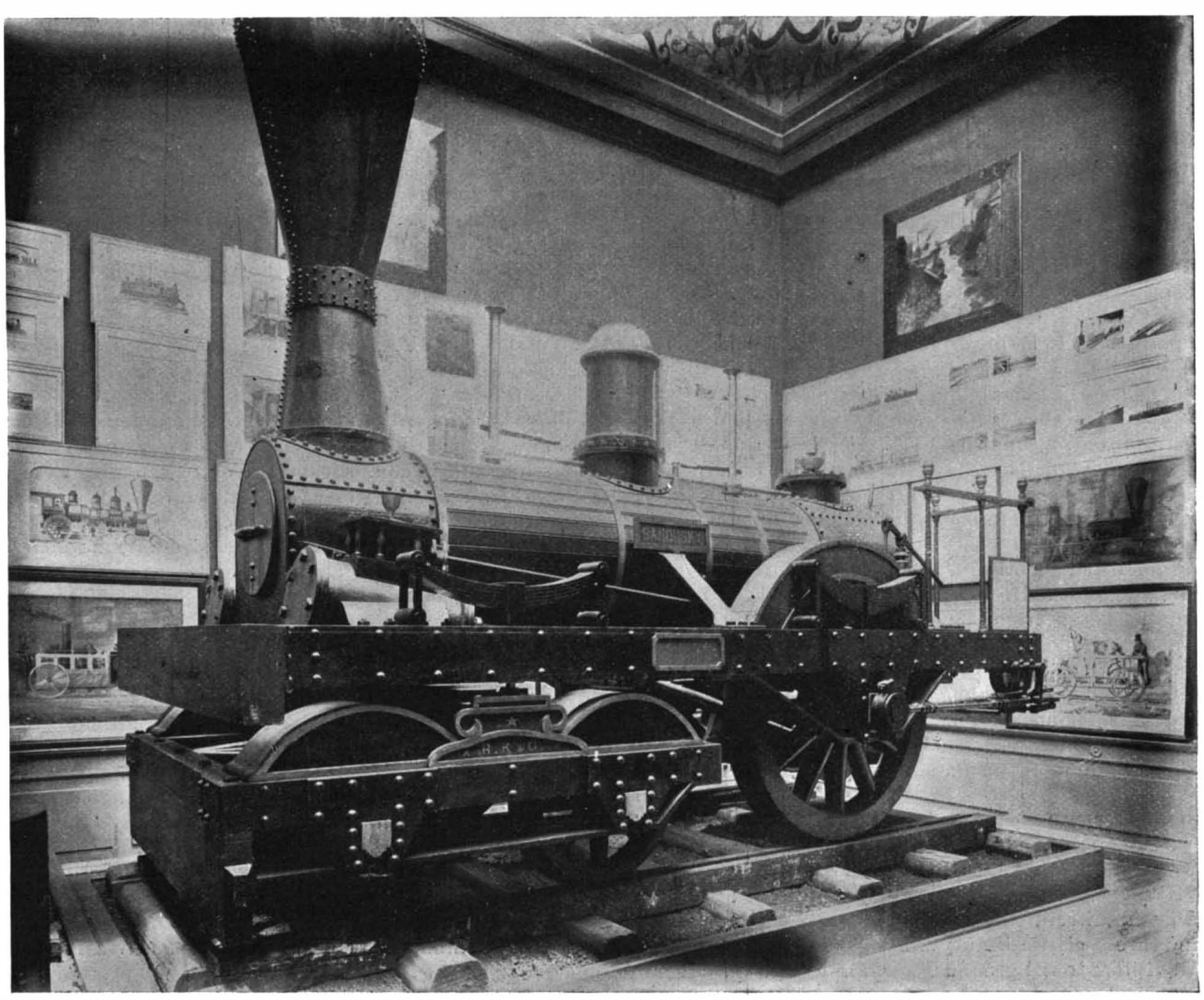


Fig. 2.—ROGERS LOCOMOTIVE SANDUSKY 1837—FIELD COLUMBIAN MUSEUM CHICAGO.

made abroad for these departments with a view to their preservation in a permanent museum.

The next step was the incorporation of the Columbian Historical Association, in Washington, early in 1892, by virtue of whose privilege as a scientific society, of receiving goods free of duty, the articles in the valuable collection of the Latin-American department were received and cared for. Of this association President Putnam was president, Prof. Wilson, of the Smithsonian Institution, vice-president, and William E. Curtis, chief of the Latin-American department, secretary and treasurer.

The public and vigorous agitation of the idea dates from the appearance of a letter by S. C. Eastman in the Tribune, July, 1893, and a series of editorials which followed in the Herald. Soon after, on August 11, 1893, a committee of three was formed at a meeting of the directors of the exposition which issued a call for a meeting of citizens "to adopt measures in immediate aid of the project to establish in Chicago a great museum that shall be a fitting memorial of the World's Columbian Exposition and a permanent advantage and honor to the city." A strong committee was formed and the title of "The Columbian Museum of Chicago" was adopted. The finance committee, subsequently formed, set about the important task of securing the funds for the endowment of the museum. At first there was but little response, and it was not until October 26, 1893, when Mr. Marshall Field made his splendid gift of $1,000,000 to the enterprise, that the good work made any successful headway. Two days subsequently Mr. George M. Pullman subscribed $100,000, and this was followed by another gift of $100,000 by Mr. Harlow N. Higinbotham.

Mr. F. J. V. Skiff, the present director of the museum, states that, as a result of Mr. Field's generosity, confidence in the assured permanence and success of the museum was renewed, and a liberal spirit was aroused among exhibitors, and especially among foreign and state commissions and American corporations and individual exhibitors, and their contributions were increased in proportion to the liberality of the endowment. How generous their contributions have been, is shown by the collections in the museum to-day The many valuable departmental collections that had been in danger of ruinous distribution at once became the unquestioned property of the museum, and by common agreement the different educational institutions discontinued their efforts to secure contributions in their own behalf and united in working for the museum. As the outcome of a suggestion of Mr. A. W. Manning in the local press, that exposition stock be donated to the museum, the present amount of stock donations approximates $1,500,000 par value from over 1,100 stockholders.

The museum committee on exhibits purchased extensively during November of the same year, securing, among other collections, those from Paraguay, Peru, Java, Samoa, and the Hagenbeck collection. At this time also the Ward collection of natural history was bought for $95,000; and about the same time the Ayer anthropological collection, valued at $100,000, was presented. The transfer of the various exhibits to their new and permanent home began on December 7, 1893; and it is thus graphically described by Mr. Skiff:

"And now began the tremendous task of gathering the vast amount of material from every part and corner and stretch and recess of these vast grounds; from all of the buildings, large and small, from the Midway Plaisance and from Wooded Island; from the Forestry building to the Fisheries building. Hundreds and hundreds of tons of exhibits, collections and objects of every describable character were transported to this building at which we are assembled. Then the selection, alteration, arrangement and rearrangement and elaboration began. Gradually hall by hall was emptied, and, as the objects of art left the building, a mass of material poured in, heterogeneous and appalling in extent. And the beautiful products of the artist's brush and the sculptor's chisel—ours for only a summer—were supplanted by what we see in these halls to-day. A sequential and systematic exposition of the wonderful and instructive things of the world we live in began to grow. Through the same door streamed boxes and bales from the Transportation, Mining, Forestry, Electricity, Manufactures and Liberal Arts, and State buildings, from government buildings and from the Plaisance; objects from the remotest lands and the most diversified climes!"

The museum was to all intents and purposes installed on May 1, 1894, and on May 21 the name was officially changed to the "Field Columbian Museum." Such in brief is the history of the founding of this famous institution.

Of the building itself no higher praise can be given than to say that it was by common consent the architectural gem of the almost uniformly excellent buildings of the exposition. It is one of the best, if not the very best, examples of Grecian architecture in America, and its vast proportions and severe classic beauty won for it the ready praise of all visitors to the grounds.

The main building is rectangular in plan and measures about 375 feet by 550 feet. The interior consists of four great courts which lead into a central rotunda which is surmounted by a dome of ample proportions. To the northeast and northwest of the main building are two pavilions, each of which is 125 feet by 200 feet in plan, access to these being had through covered galleries. The total depth of the building, measured from the southern facade of the main building to the north front of the pavilions, is 500 feet, and the total width, measured across the pavilions, 1,100 feet.

It would be quite beyond the limits of the present article to speak in lengthy detail of the various collections which have found a permanent resting place in the museum. There is none that possesses greater interest than the collections presented to the museum through the Latin-American department of the exposition. This comprises the historical Columbus exhibit, which consists of a series of object lessons illustrative of the history and development of America, from the birth of Columbus to the present day. Here is also a collection of articles which show the civilization of the aboriginal races of America prior to the landing of Columbus. The historical Columbus exhibit was gathered mainly through the efforts of specially appointed army and navy officers, who worked with great success in Spain, Mexico, and the smaller American republics. The efforts of Mr. Curtis, who had charge of this department, resulted in a priceless collection of documents relating to Columbus which was shown at the exposition. These were photographed, and the photographs now form part of the museum collection. In this collection will also be found the rare collection of relics and historical paintings and photographs which was shown in La Rabida Convent during the exposition.

The collection presented through the exposition departments of agriculture and forestry owes its completeness largely to the forethought of Mr. W. I. Buchanan, chief of the department of agriculture at the exposition, who laid his plans for collections long before the idea of a museum had been publicly mooted. At his solicitation, carefully selected exhibits were presented to the museum by Russia, Japan, Mexico, Brazil, British Guiana, Corea, and many other countries, and the United States Department of Agriculture responded with a complete collection of tobaccos, fiber plants, cotton, and a series of forest trees. In this collection will also be found a notable contribution from the Forestry building. The entire collections of Japan, British India, Brazil, and Mexico were turned over to the museum complete, and many of the States which are notable for their forests added valuable selections from their exhibits.

The museum is indebted very largely to Mr. F. J. V. Skiff, the present director of the museum, for the collections presented through the exposition department of mines, mining and metallurgy.

The department of mines, mining and metallurgy found that while an unexcelled showing from various localities or of isolated mining and metallurgical industries would be made at the exposition, no comprehensive survey would be made unless under the immediate direction and supervision of the department. As a result, five national and technological special collections were projected. All of these collections having been exploited by the use of exposition funds, were at the close of the exposition, by vote of the board of directors, transferred to the Field Columbian Museum.

These were: A collection of the mineral combustibles of the United States. A collection of the building and ornamental stones of the United States. A graded collection illustrating the metallurgy of the precious and base metals. A collection of transparencies. A collection of the literature pertaining to the subjects of mining and metallurgy.

The exposition department of archæology and ethnology presented a collection which had been gathered by special expeditions sent out under the direction of Prof. Putnam, whose orignal idea was to use the opportunity offered by the exposition to assemble a vast number of anthropological objects representing the American peoples. The collection was made with a view to its use in a permanent museum, and it comprises objects which have been gathered from a field which included practically the whole of the new world.

The geological collections are arranged in two groups. Those illustrating geology as a theoretical science are grouped in the division of systematic geology; those setting forth its practical bearings, in the division of economic geology. The collections of the former class occupy eight halls of the museum, those of the latter, thirteen. Three halls are devoted to the section of paleontology, in which 5,000 specimens are displayed. The collection of meteorites is one of the largest in the country. The section of systematic mineralogy contains 5,000 specimens, and the section of lithology contains 15,000 specimens 1 inch by 3 inches by 4 inches and 400 larger polished slabs.

The collections of the division of economic geology were obtained through the efforts of the chief of the department of mines, mining and metallurgy of the World's Columbian Exposition from exhibits made in that exposition. Being designed to illustrate the practical bearings of the science of geology, they consist chiefly of specimens which show modes of occurrence in nature of the minerals which have economic importance and the localities where they may be obtained. In addition to these, however, are many illustrations of the processes employed in the extraction and treatment of such minerals or ores and of the application of resulting products to human arts and industries. While these ultimate products may seem to have little relation to geology, the fact that they are the ends sought by the application of its principles entitles them to a place in the series. Moreover, as denominators of groups, they furnish the simplest and most readily understood basis of classification.

The botanical collection has been placed in the galleries of the building, the director having decided that they would furnish the best light and most advantageous position for the treasures which had been so generously donated. It includes the Japanese exhibit that was shown in the Manufactures building, and also the display from the Forestry building. This latter was one of the most complete exhibits in the building, and the museum is proportionally enriched. Russia, British India, the Central American countries, and the United States are fully represented, and a complete collection of the sylva of this country, both commercial and noncommercial, is to be added in time.

The department of zoology includes all the classes of animals except that of birds, and for this material six large halls of the museum have been set apart. The most interesting and valuable of these groups is that of the Cœlenterata, in which are included 300 species of corals.

Ornithology has found a home mainly in a hall which is used as an exhibition room for the mounted birds. Here will be found the "Cory collection," of West Indian birds, and also the fine ornithological library of C. B. Cory.

Anthropology, covering a wide field in the interests of the race and furnishing a vast range of materials available for museum purposes, naturally becomes a prominent feature in the young museum. The founders were fortunate beyond precedent in securing at the outset extensive and important collections representing many widely separated portions of the world. In this department will be found such matter as relates to comparative primitive culture, besides such of the phenomena of higher culture as have little direct bearing on the material interests of civilized people. Here are the physical and psychical laboratories and collections of cranic casts, etc., illustrating the physical characteristics of man.

The collections may be classified as to their immediate origin under the following heads: First, those acquired by the department of ethnology of the exposition, by collection, purchase and gift and transferred to the museum at the close of the Fair; and, second, those acquired by the museum directly, by collection, purchase and gift, during the period of twelve months intervening between its inception and the present date. Aside from these resources, the presence of a number of loan collections adds to the volume of exhibits.

The collections in the department of industrial arts have been classified and arranged with a view to showing the more important steps which have led to improvement in handiwork, or progress in the invention of those machines and processes which have contributed most to the world's material development. Under this head a section has been set apart to illustrate the development of the art of weaving and spinning. Here are shown an old loom used in Kentucky during the last century and what is probably the first Jacquard loom used in America. A loom is shown from Japan, together with native Japanese tapestry, and specimens of weaving machinery and its product from widely distributed parts of the world are gathered in this section of the museum.

Perhaps it is safe to say that there is no historical exhibit that is more complete, or full of intrinsic interest, than the collection presented to the museum through the exposition department of transportation exhibits. This exhibit was planned to show the gradual development of transportation methods from the earliest records down to the present time. The result has been a most comprehensive collection, which ranges from a light Scythian racing chariot, dug from an Egyptian mummy pit, to a perfected type of the American eight wheeled locomotive. The most striking feature of this collection is the historical railway exhibit, which occupies the greater part of the east pavilion. The most complete section is the collection of relics, models, photographs, drawings, and reproductions collected and prepared by the Baltimore and Ohio Railroad Company, through Major J. G. Pangborn, and by the Pennsylvania Railroad Company, through Mr. J. Elfreth Watkins. Major Pangborn was dispatched to England with instructions to buy up all the historical data that was accessible and purchasable; and so well did he carry out his instructions that there is now installed in the Field Columbian Museum a more complete set of historical plans, photographs and general data of early English locomotives than can be found in any one place in England. Our attention was drawn to this curious anomaly by Mr. C. E. Stretton in a letter to which we made reference in a recent issue. In this collection, for

instance, will be found the working drawings—most of them originals—of the early locomotives built by Edward Bury, afterward Bury, Curtis & Kennedy, for what is now known as the London and Northwestern Railway. It also includes either the original working drawings or copies of the early Great Western Railway engines; and any one who is acquainted with early English railway history will appreciate the great value of this data.

This very remarkable collection also embraces thirty-eight full size working reproductions of locomotives for road and rail covering a period from 1680 to 1848. It also includes fifteen original locomotives of the type built from 1832 to 1876.

Another notable feature in this collection is the elaborate series of drawings, showing the development of motive power from the earliest to the present time, and the very handsome display of photographs.

The locomotive models are grouped historically in the various rooms, and are standing upon specimens of the track and roadbed which were contemporaneous with the locomotives they carry. The drawings and photographs are grouped upon the walls with a similar regard for their historical order.

We present two photographic views of the interior of this section of the museum which are characteristic of the general excellence of the exhibit. They both represent full sized models of the original locomotives and the system of track which was in use at the time they were built. The engraving also shows a portion of the valuable collection of drawings and photographs which is disposed upon the walls of the exhibition rooms.

Apart from its interest to the curious and casual sightseer, this exhibit has a special value to the historian. Whoever may have occasion to write upon the too much neglected subject of locomotive history will find a rich treasure house of authentic relics in this collection. We are gratified to note that there is evidence of a widespread and growing interest in the general question of railway and, especially, locomotive history, and we think that the present time will be opportune to put before our readers a series of articles by Mr. H. T. Walker, on the history of the American locomotive. The first of these articles will appear in the next issue of the SCIENTIFIC AMERICAN, and they will be continued in the two succeeding issues. They will be profusely illustrated with line drawings and photographic reproductions of the most famous engines in the Field Columbian Museum exhibit, the photographs being taken in the halls of the museum by the courtesy of the director, Mr. F. J. V. Skiff, to whom we are indebted for much detailed information regarding the history and present standing of the museum.

The Birthplace of Buddha.

All students of ancient Indian history, says the Pioneer, and all followers of Buddha are indebted to the present enlightened government of Nepal for the discovery of the actual spot of the long-lost birthplace of Buddha Sakya-Muni. On representations made by the government of India, the Nepalese Prime Minister granted permission to the Archæological Surveyor of the Northwest Provinces to visit the Nepal Terai this winter in order to explore the country for a distance ten miles to the northwest of Mauza Nigliva, where now stands Konagamna, Buddha's Nirvana-stupa, and Asoka's monolith recording that fact. General Khadga Shamsher, Governor of Palpa, was instructed to meet Dr. Fahrer at Nigliva and to receive suggestions from him regarding the contemplated excavations among the ruins at this spot.

By a lucky chance, the meeting could not take place at Nigliva, but came about instead about fifteen miles to the northeast at Mauza Paderiya, near the tahsil of Bhagwanpur in the zillah of Butaul, close to the general's camp. Here, near the debris of several ruined stupas, stood one of Asoka's monoliths, rising about ten feet above the level of the surrounding ruins and covered with several pilgrims' records, of which one belongs to about the ninth century. The archæologist's attention was at once caught by this, and the pillar was unearthed to the depth of another fourteen feet, when a well-preserved inscription of the great Emperor Peyaddassi or Asoka was found about three feet below the former level of the ruins. In this inscription Asoka states that, after having been anointed twenty years (about B. C. 239), he came himself to the garden of Lumbini, worshiped, and erected several stupas and this column on the very spot where Lord Buddha was born, in order to commemorate this happy event for future generations.

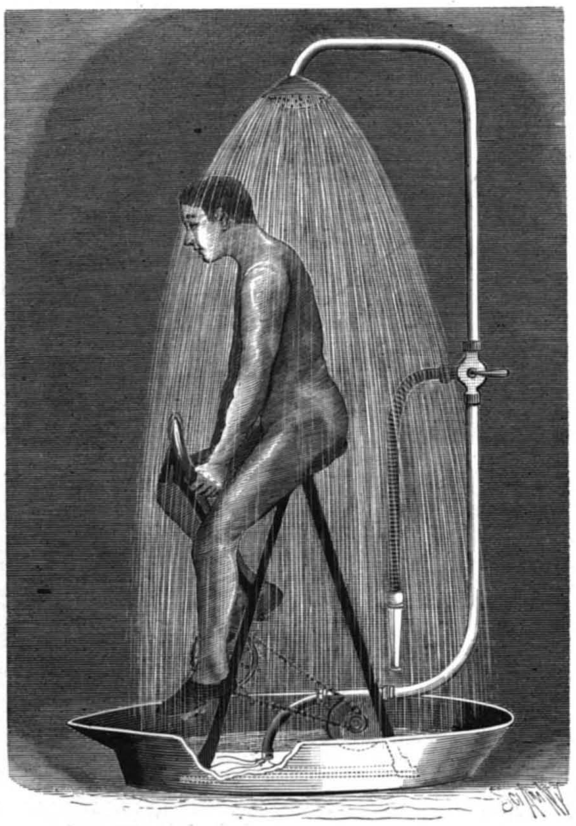
About eighteen miles northwest of this column lie vast ruins of stupas, monasteries, and palaces covered with forest and stretching in a straight line of about five miles from the village of Amouli to Tilaura Kot on the Banganga River, the circumference being about seven miles. This is the ancient site of Kapilavastu, the capital of Suddhodana, Buddha's father. The whole place is as dreary and desolate as when seen by Fa-Hian and Hiuen Tsiang in the fourth and sixth centuries A. D. The Nepalese durbar had permitted a thorough excavation of these vast ruins during this winter, but as the famine is worse in the Nepal Terai than in the adjoining British districts, General Khadga Shamsher thought it wiser and safer not to collect a great number of workmen on one spot for several months, and has promised to have the excavations carried out by his sappers and miners next winter. We may confidently expect great results from this exploration, as undoubtedly pre-Asoka inscriptions will be turned up on the spot.

A VELOCIPEDE SHOWER BATH.

At the recent cycle show in Paris, a prominent English bicycle manufacturer presented a novelty called a "Vélo-Douche," which is an eminently practical device for combining exercise and the morning ablutions. Many wheelmen have doubtless often desired to obtain a shower bath after violent exercising on the wheel, so as to obtain the sedative effect of the brisk reaction.

Many bicycle and athletic clubs are provided with every facility for obtaining this end, but such means are not always at the disposal of the rider, especially in the country.

The device which we illustrate is really a combination of the home exerciser and shower bath, and it enables the rider to obtain any amount of exercise desired with or without the bath. The machine consists of a shallow tub to which is secured a framework carrying a bicycle saddle, a handle bar, pedals, sprocket wheels and chain. The resemblances to the bicycle go no further. The small sprocket wheel which is driven from the large sprocket on the main shaft by the medium of a chain is secured to a small rotary pump which is fastened at the rear of the frame. The suction pipe



A VELOCIPEDE SHOWER BATH.

of the pump ends near the bottom of the tub and the discharge pipe is curved as shown in the engraving and ends in the sprinkler arrangement common to all shower baths. A cock half way up the discharge pipe permits of the water being turned on to the sprinkler or through the hose and nozzle, depending on whether a bath is desired or not.

It is, of course, perfectly possible to obtain the exercise without getting wet, the pump furnishing the resistance necessary for the exercise and the water which is pumped being discharged by means of the rubber tube and nozzle. When the rider has exercised sufficiently, he can reach backward and turn the cock so as to let the water pass upward and out of the sprinkler. The harder he pedals, the larger the stream.

It is possible to direct a stream of water on any part of the body by means of the nozzle connected with the rubber tube. The tub can be divided into two compartments, one containing hot water and the other cold water, and the cold and hot douche may then be used at will. The device could be made to set in any ordinary bath tub. It would seem that the "Vélo-Douche" has a future for use in the cycle clubs, riding academies, sanitariums and in the army.

THE price of a regular full weight motor carriage in France is $1,000. Bollée's light carriages sell for $500 and the motor tricycles made by Dion & Bouton cost $320 each. These prices are considered too high in France. Another obstacle to the development of the motor carriage industry is the threatened collection by some French towns of an "octroi" or local duty on the kerosene or the like carried by all motor carriages entering the city limits.—Revue Geographique Internationale.

Archæological News.

A mosaic map of Palestine thirty feet long by fifteen broad has been discovered at a village between Salt and Kerak, east of the Jordan. The pavement is believed to belong to the fifth century after Christ.

A bronze figure just discovered in the Amsterdam Museum is believed by the director to be by Michelangelo. It represents King David dancing naked before the ark. Such attributions in Michelangelo's case should be received with extreme caution.

From Greece comes the news of the discovery on the island of Salamis of stones inscribed with epitaphs composed by the celebrated poet Simonides for the tomb of the Corinthians who lost their lives in the great battle of Salamis. With the assistance of the indications contained in the epitaph, a diligent search is now being pursued for the discovery of the tombs of the Corinthians who played a leading part in that historic contest.

Excavations at Athens.—After long delay, owing to the difficulty of buying land in this thickly populated part of the city, Dr. Dörpfeld has resumed his excavations near the Theseion, says The Builder. Another house in the Poseidon Street has been bought and pulled down, and beneath it the south wall of the building he conjectures to be the Stoa Basileios has been laid bare. This building is now seen to consist of a hall nearly square in shape, nine meters in breadth. Its east side has a portico, and from the dowel marks in the stylobate of this portico it is clear that it had six columns. The plan is obviously such as we are accustomed to associate with a small temple, but against this view and in favor of the Stoa Basileios identification are two main arguments. First, the square-shaped hall has in its north wall a small door, a thing unprecedented so far in a Greek temple, and secondly, though this argument is, of course, less strong, topographical considerations are against it. Dr. Dorpfeld himself still clings to the view that the building is the Stoa. The masonry points to the end of the sixth or beginning of the fifth century, and for this date the size of the building is adequate for the official seat of the Archon Basileus. Further, there is a basis set against the back wall that would serve well as the foundation of the altar, which must have stood in the Stoa. South of the building a broad stairway leads up to the Theseion. We hope some more decisive evidence may come to light, as the identification is of great topographical importance.

How Tomatoes are Preserved in Italy.

In every house and cottage the preserving of tomatoes is carried on. Terraces, balconies, and even the flat roofs of the houses are half covered with plates containing the deep-red substance. After gathering, the tomatoes intended for perserving are spread out for some hours in the sun till the skin has somewhat shrunk. They are then passed through a sieve so that they may be freed both from seeds and skins. As they contain a large proportion of water, the substance which has been passed through the sieve must be hung in bags, from which the water exudes, and soon a pool of dirty-looking water is formed beneath each bag. Strange to say, it is in no way tinged with red. The mixture which remains in the bags has the consistency of a very thick paste. It is then salted, the proportion being a little less than an ounce of salt to a pound of preserve. The process now requires that it should be spread on flat plates, exposed to the sun, and stirred from time to time with a wooden spoon, so that the upper part may not form a crust, while underneath it remains soft. It is a picturesque sight when the women are to be seen flitting about on their roofs and terraces, attending to their deep-red preserve, their colored handkerchiefs flung on their heads to screen them from the rays of the burning sun when it is at its fiercest. In the evening the contents of the various plates are taken in and stirred up together, for if moistened by the night dew the whole would be spoiled. After being exposed to the sun for seven or eight days, the same process being repeated each day, the preserve is finished and placed in jars for winter use.

Though it is used by all classes of persons, it is more necessary to the poor than to the rich, for the latter can make use of the fresh tomatoes preserved in tins. Tomatoes may be tinned whole, as we know from those usually imported into England from America. But in Italy the fruit is usually passed through a sieve, the pulp being then placed in tins, which are immediately soldered down, and then put in boiling water for five minutes. The original flavor is thus retained. The cost of a small tin is half a franc. So it is, as a rule, beyond the means of the poor. The price of the preserve is seldom more than sixteen cents a pound, and a little of it goes very far; but those who are thrifty take care to make it for themselves, the cost then being absolutely insignficant. It is chiefly used by them for flavoring their macaroni in the winter; in fact, there are very few dishes which are not improved by a little tomato preserve, and it finds favor in all classes.—Chambers's Journal.

RECENTLY PATENTED INVENTIONS.

Engineering.

STEAM BOILER FURNACE.—William C. Douthett, Pittsburg, Pa. The grate bar of this furnace is composed of a main section having in its top alternating heads and spaces and agitating sections provided with blocks operating in the spaces, and having lateral shoulders by which to engage the main section and limit the downward movement of the blocks. The grate bars are supported by shafts which form parts of rockers, and by rocking the shafts in one direction the blocks of one section of the grate bars are tilted upward, while by rocking the shafts in the other direction the blocks of the other section are tilted upward.

MOVABLE DAM, ETC.—William L. Marshall, Chicago, Ill. This invention relates to dams or sluiceway gates of the bear trap type, and provides a construction whereby sliding friction is avoided, all trouble from drift is obviated, and the greatest possible height of dam in proportion to width of leaves may be obtained, the dam easily closing flat, and being started from rest with the least head of water. The invention consists in extending the leaf that is effective in forming the dam one-half or slightly more than one-half of its width above and beyond the line of attachment of the two leaves, to increase the height or lift of the dam relative to the width of base, and at the same time reduce the volume of the hydraulic chamber. The two leaves are connected at or just above the center of pressure upon the extended leaf.

WELL PUMPING POWER.—George W. Grimes, Bluffton, Ind. An improvement has been devised by this inventor in power devices for operating pump rods or lines for either water or oil wells in great numbers from a central station, the improvement insuring uniform motion and great efficiency in the use of power. A post extends upward from a bedplate and a sleeve rotating on the post has an annular flange at its lower end with a groove registering with a groove in the bedplate, there being anti-friction balls in the grooves and a drive wheel secured to the lower end of the sleeve. A ring plate is mounted on the drive wheel eccentric to its axis, there being a pump line plate on the ring and anti-friction rollers carried by the plate and bearing against the periphery of the ring.

Railway Appliances.

GUARD FOR SIGNAL HANDLES.—George M. French, Mattoon, Ill. To prevent the improper handling of train order or block signals, from the neglect or forgetfulness of telegraph operators and others, this inventor has devised a guard for pivotal attachment to the signal operating handle, the guard being provided with spurs which may be used as a file to receive orders and papers. When in safety position the guard will not interfere with the working of the signal, but when in danger position it prevents the operator from grasping the handle, and so calls his attention to the fact that it must not be moved, the train orders, etc., being brought immediately before the operator when he attempts to operate the signal.

Electrical.

BICYCLE LIGHT.—David W. Stinson, St. Louis, Mo. A strong and efficient light is provided by this invention, the electricity therefor being generated by the motion of the wheel, while a governor operates to maintain a steady and uniform power for the lamp. The lamp and generator are preferably held in a casing removably attached to the steering fork. A friction wheel engages the forward wheel of the bicycle, and a friction disk on a vertical shaft engages the side of the friction wheel, this friction disk being raised and lowered, as the speed of the wheel is greater or less, by means of a governor consisting of toggle joints separated by a spring. The vertical shaft rotates the armature within segmental field pieces, a high speed causing the friction disk to move in toward the axis of the friction wheel, while with lower speeds it approaches its periphery, thus maintaining the generation of a substantially uniform current.

NOTE.—Copies of any of the above patents will be furnished by Munn & Co. for 10 cents each. Please send name of the patentee, title of invention, and date of this paper.

NEW BOOKS, ETC.

STEAM AND HOT WATER FITTER'S TEXT BOOK. By Thomas E. McNeill. New York: David Williams. Pp. 140. Price $1.

A book which contains the substance of a course of lectures delivered at the New York Trade School to young workmen, or those who are fitting themselves to be such, in this special department of labor, ought to be exceedingly plain in its description, and thorough in its attention to details—a character which is fully borne out in this little text book. The contents are arranged in the form of question and answer, and the book has numerous illustrations. Any young plumber, desiring to take up this line of work, cannot do better than make himself master of the information here so concisely and fully presented.

The American Educator, a work in four large quarto volumes, is in course of publication, and announced to be completed about June 1, by the Syndicate Publishing Company, of Philadelphia, whose announcement will be found on another page. It promises to be a work of great merit, bringing down facts and figures to March 15 of this year. Although designed as a general encyclopedia of universal knowledge, it will give particular attention to the newest subjects, treating fully of the recently threatening bubonic plague; giving plans and details of the proposed new Hudson River Suspension Bridge, at New York; aeronautics and balloon voyages; battle ships and cruisers; agricultural chemistry, bacteriology, etc.; the latest electrical experiments, monetary theories, new inventions and discoveries, etc. The work will also be an up-to-date biographical dictionary and gazetteer of the world. Especial inducements are offered to those ordering the work in advance.

Business and Personal.

The charge for insertion under this head is One Dollar a line for each insertion; about eight words to a line. Advertisements must be received at publication office as early as Thursday morning to appear in the following week's issue.

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Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7143) L. J G. asks: 1. Could a storage battery be made from some small tumblers with lead plates? A. A storage battery could be made as described. It would be rather small for advantageous results. 2. Are the separate cells connected the same as a number of dry batteries? They are to be charged by eight bichromate of potassium batteries. A. Connect in series for charging. For use connect according to work they have to do. 3. What candle power are these batteries supposed to give? Each one contains 2 carbons and 1 zinc. A. You may allow about one candle power for a quart bichromate cell.

(7144) E. J. B. asks for a recipe for mixing coal tar, and applying it as a roof paint, also if it can be shaded by minerals and how. A. Coal tar for roof or fence painting can be mixed with any common dry mineral paints, such as chrome yellow, oxide of iron or Princes' metallic paint and thinned with naphtha or turpentine to allow of using a brush. The colors cannot be made bright, but will be of dark buff or brownish red.

(7145) A. W. asks how it would do to make the field magnet for the simple electric motor all in one piece of wrought iron 2½ inches in width by $\frac{1}{16}$ inch thick, and also could the armature core be made of an iron ring instead of the winding of the wire; would this give entire satisfaction? A. You can make the field as you specify, but the armature core should be of wire; by no means of solid iron. A solid core will be the seat of Foucault currents and will be a source of waste of power.

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AND EACH BEARING THAT DATE.

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Cotton goods, especially sheetings and drillings, Tata & Company 29,714
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Wood preservatives, American Wood Preserving Company 29,730

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